SERVICE MANUAL

CS-1570A

DUAL TRACE OSCILLOSCOPE

TRIO

FEATURES

The Model CS-1570A Triggered Sweep Dual-Trace Oscilloscope is a laboratory quality, professional instrument for observing and measuring waveforms in electronic circuits. Dual vertical inputs are provided for simultaneous viewing of two waveforms. Low-frequency, low repetition-rate waveforms are chopped at a 200kHz of the two of high-speed, high repetition-rate waveforms. In addition the sum or difference of the two input waveforms can be displayed as a single trace. The built-in signal delay line insures that the leading edges of fast rise-time, short-duration pulses are always visible.

The dual-trace feature, together with the 30MHz bandwidth, wide range of sweep speeds, and high sensitivity provided, make this the ideal oscilloscope for a broad range of applications, including troubleshooting and repairing electronic equipment, research and development, and laboratory instruction.

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SPECIFICATIONS

Cathode Ray Tube

Type: H9155A-P31 or E2729B31A (130 mm)
Accelerating voltage: 5.2 kV
Scale: 8 div x 10 div (1 div = 1 cm)

Vertical Amplifiers (for both CH1 and CH2)

Deflection Factor: 5mV/div~5V/div, 1-2-5 sequence Precisely adjustable between all ranges. Sensitivity error between ranges is ±3%.
Input Impedance: 1 MΩ ±2%
Input Capacitance: 23 pF ±3pF
Frequency Response: DC DC-30 MHz
(less than −3 dB)
AC 5 Hz ~ 30 MHz
(less than −3 dB)
Risetime: Less than 11.7 nsec.
Over-shoot: Less than 3%
(at 100 kHz square wave)
Cross-talk: Better than −66 dB at 1 kHz
Operating Modes:
CH1: Channel 1 only
CH2: Channel 2 only
DUAL: 2-channel (CHOP and ALT are automatically selected by SWEEP TIME/DIV) 0.2μs/div~ 0.5 ms/div: ALT (alternate sweep)
1 ms/div ~ 0.5 s/div: CHOP (200 kHz switching)
ADD: Single-trace algebraic sum of CH1 and CH2
CH2 polarity: Normal or inverted. When inverted, provides CH1 minus CH2 presentation, when in the ADD mode.
Maximum Input Voltage: 600 Vp-p or 300V (DC + AC peak)
Signal Delay: More than 12 nsec (on the CRT surface)

Sweep Circuit (Common to CH1 and CH2)

Sweep System: Triggered (NORM) and automatic (AUTO). In Automatic mode, sweep is obtained without input signal.
Sweep Time: 0.2 μs/div ~ 0.5 s/div ±3%, 1-2-5 sequence. Fine adjustment between all 20 ranges.
Sweep Magnification: Obtained by enlarging the above sweep 5 times ±10% (PULL X5 MAG) from center.
Linearity: 3% or better

Triggering

Source: CH1, CH2, EXT1 and EXT1/10. During single trace operation, CH1 and CH2 are triggered automatically by the operating modes.
Method: NORM, FIX; when the FIX button is in the FIX mode, the sweep triggers automatically at the average level of the display of waveform.
Slope: Positive or negative
Coupling: AC, LF Rej, HF Rej and DC
Sensitivity:

Sync. coupling	Sync. frequency range (Hz)	Minimum sync. voltage		
		INT	EXT 1	EXT1/10
AC	10 ~ 30M	1div	0.5Vpp	5 Vpp
	20 ~ 15M	0.3div	0.1Vpp	1 Vpp
LF. Rej	10K ~ 30M	1div	0.5Vpp	5 Vpp
	20K ~ 15M	0.3div	0.1Vpp	1 Vpp
HF. Rej	10 ~ 300K	1div	0.5Vpp	5 Vpp
	20 ~ 50K	0.3div	0.1Vpp	1 Vpp
DC	DC ~ 30M	1div	0.5Vpp	5 Vpp
	DC ~ 15M	0.3div	0.1Vpp	1 Vpp
PULL AUTO (PULL)	10 ~ 20M	1div	0.5Vpp	5 Vpp
	20 ~ 15M	0.3div	0.1Vpp	1 Vpp
FIX (AUTO)	20 ~ 20M	1div	0.5Vpp	5 Vpp
	40 ~ 15M	0.5div	0.2Vpp	2 Vpp

Video Sync. (FRAME and LINE are automatically selected by SWEEP TIME/DIV)
LINE: 0.2 μs/div ~ 50μs/div
FRAME 0.1 ms/div ~ 0.5 s/div

Horizontal Amplifier (Horizontal input thru CH2 input)

X-Y Operation: With SWEEP TIME/DIV switch in X-Y position, the CH1 input becomes the Y input and the CH2 input becomes the X input. The X-Y position control becomes the horizontal position control.

SPECIFICATIONS

Deflection Factor: Same as CH2.

Frequency Response: DC DC ~ 2 MHz (less than −3 dB)
AC 5 Hz ~ 2 MHz (less than −3 dB)

Input Impedance: Same as CH2 (1 MΩ ±2%)

Input Capacitance: Same as CH2 (23pF ±3pF)

Calibrating Voltage

0.5 Vp-p ±1% reference level 0V (1 kHz ±3% square wave)

Intensity Modulation

Input Voltage: TTL logic-compatible, high logic increases brightness; low logic decreases brightness.

Input Impedance: 10 kΩ

Bandwidth: DC ~ 5 MHz

Maximum Input Voltage: 50V (DC + AC peak)

Trace Rotation:

Trace angle is adjustable by panel surface adjuster.

Power Requirements

Power Supply Voltage: AC 100/120/220/240V, ±10% 50/60 Hz

Power Consumption: 25W

Dimensions

Width: 260 mm (277 mm)

Height: 190 mm (204 mm)

Depth: 375 mm (440 mm)
Figure in ( ) show maximum size.

Weight:

8.5 kg

Accessory

Probe:
PC-28 2
Damping..... 1/10
Input Impedance ..... 10 MΩ
Input capacitance
..... less than 18 pF

Instruction Manual: 1 copy

Replacement Fuse:
0.7A 2
0.3A 2

CRT H9155A-P31 SPECIFICATION

Screen and Shape

Dimensions:
Overall: 355mm
Face plate dimension: 133 ± 1.8 mm

Screen shape: Round and Flat face

Focusing: Electrostatic deflection and focusing Post accelerating

Fluorescence: Green

Persistence: Midium short

Display Area: 110x90mm^2

Heating

Heater voltage (Ef): 6.3V ± 10%

Heater current (If): 0.095A ± 10%

2nd Plate voltage: 1400V

Capacitance

G1 to all other element: 7.5pF

K to all other element: 4.0pF

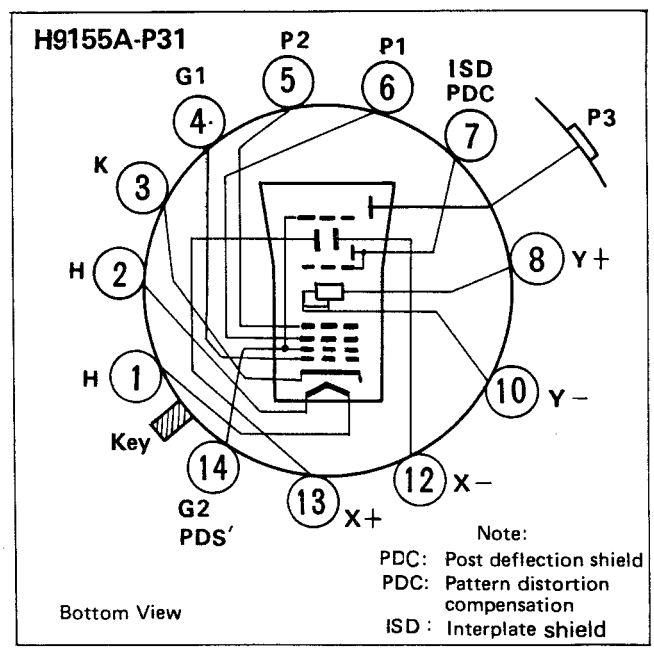


Fig. 1 CRT Basing

CIRCUIT DESCRIPTION BLOCK DIAGRAM

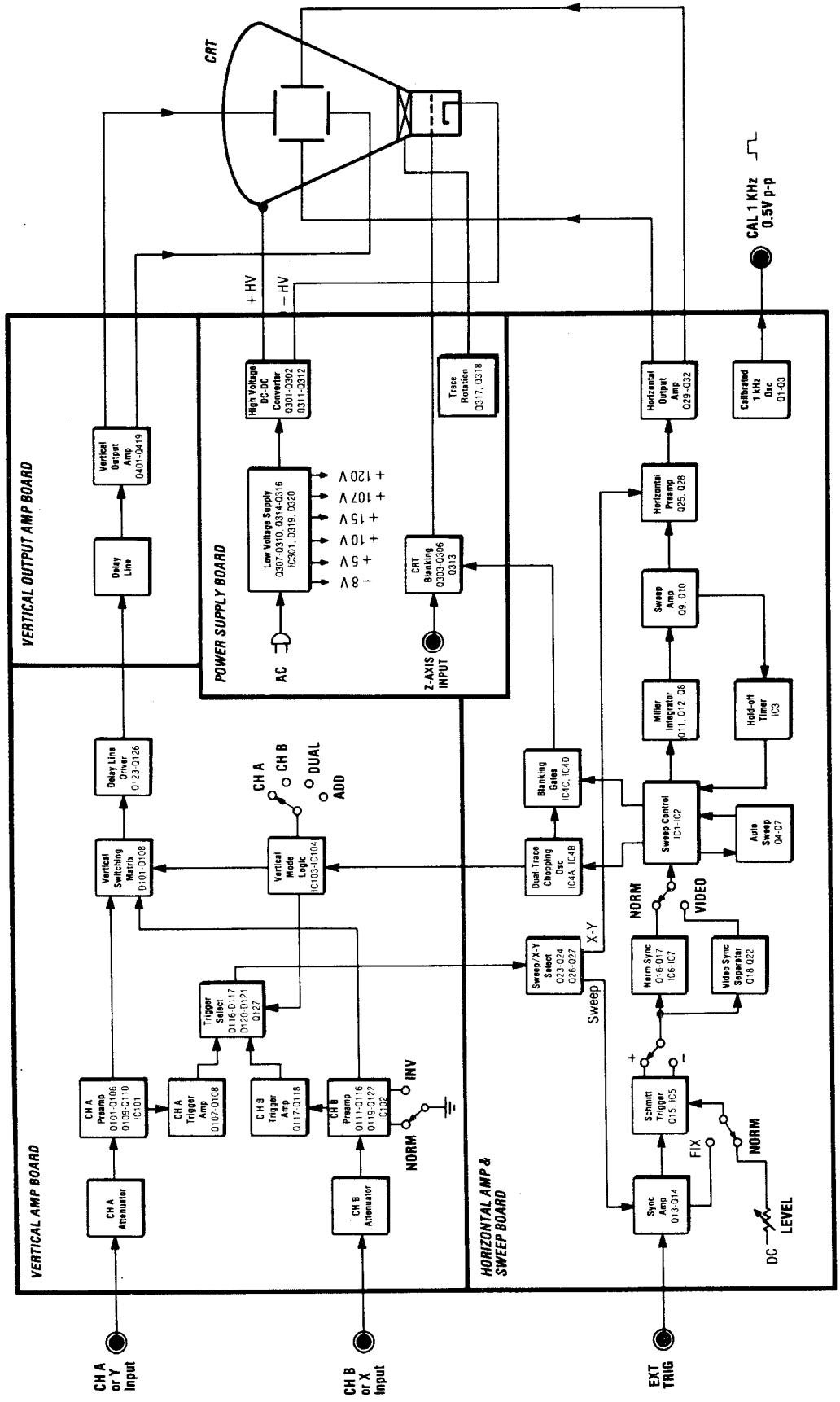


Fig. 2

CIRCUIT DESCRIPTION

The block diagram, Fig. 2 outlines the circuit breakdown of the oscilloscope. Circuit details are obtained by reference to the schematic diagram.

GENERAL

The vertical section includes identical networks for Channel 1 and Channel 2, each containing an input attenuator network and preamplifier. The outputs of the preamplifiers can be gated to the delay line driver by the vertical switching matrix. The vertical switching matrix, through the MODE switch and vertical mode logic, gates only the Channel 1 signal in CH 1 mode and X-Y operation, only the Channel 2 signal in CH 2 mode, alternately gates each in DUAL mode, or simultaneously gates both in ADD mode:

The delay line driver feeds into the delay line, which delays the vertical preamplifier signals approximately 160 nanoseconds before they reach the vertical output amplifier. The vertical output amplifier drives the vertical deflection plates of the CRT.

Horizontal deflection is provided by the horizontal preamplifier and horizontal output amplifier. In all except X-Y operation, input to the horizontal preamplifier is furnished by calibrated sweep speed circuits consisting of the sweep control circuit, Miller integrator, and hold-off timer. The sweep can be synchronized to the Channel 1 and 2 input signal or an external trigger. The auto sweep circuit can start the sweep in the absence of a synchronizing trigger.

When X-Y operation is selected, the Channel 2 signal is coupled to the horizontal preamplifier for horizontal deflection and the sweep circuits are disabled.

The power supply voltages are fully regulated, and a dc-to-dc converter provides a regulated 4kV accelerating potential to the CRT.

VERTICAL PREAMPLIFIERS

Channel 1 and Channel 2 preamplifiers contain identical circuitry and circuit operation is the same for both. Channel 1 is described below.

The vertical input attenuator, S103, has two sections. The first provides ratios of 1:1, 10:1, 100:1 and 1000:1. The second section provides ratios of 1:1, 2:1 and 5:1. Together, the two sections give an attenuation sequence of 1-2-5, with the appropriate exponent. After first attenuation section, FET's Q102a and Q102b form a high-impedance input stage of the vertical preamp. This balanced configuration provides compensation for thermal drift and power supply voltage fluctuations. Q101 and D122 are used for negative over-voltage protection. Positive over-voltage is clamped by Q102a. Op-amp IC101 feeds the second attenuation section. Q103 thru Q106, Q109 and Q110 further amplify the vertical signal before it reaches the delay line driver, transistors Q123 to Q126. Trigger amplifier Q107 and Q108 amplify the signal from the emitters of Q105 and Q106 to provide a signal to the sweep trigger circuits.

The only difference between the CH 1 and CH 2 preamplifiers is that the CH 2 polarity switch, S105, reverses the polarity of the CH 2 signal when in the INV position. This is accomplished by switching on either transistor pair Q119/Q122, or Q120/Q121.

DELAY LINE

The delay line is a length of cable which delays the vertical signal from the delay line driver for approximately 160 nanoseconds before it reaches the input stage of the main vertical amplifier. The purpose of this delay is to enable the sweep to be triggered before vertical deflection begins, which allows one to see the leading portion of very fast rise-time signals.

VERTICAL OUTPUT AMPLIFIER

The output of the delay line feeds into the vertical output amplifier. Q401 and Q402 form a differential amplifier which goes to another differential stage Q403 and Q404. These connect to emitter followers Q405 and Q406, which drive cascode amplifiers Q408, Q410, and Q409, Q411. Negative feedback from the cascode amplifiers goes via inverters Q414 and Q415 to the bases of Q405 and Q406. Q412, Q418, and Q413, Q419 comprise current sources for the cascode amplifiers. Emitter followers Q416 and Q417 help drive the current-source transistors, Q418 and Q419, when extra current is required for fast signals.

MODE LOGIC

The mode of operation (CH1, CH2 DUAL, ADD), S106, is controlled by IC103, IC104, and diodes D101-D108. When CH1 is selected, the IC104 Q output is high and the $\bar{Q}$ low, which reverse biases D101 and D104, allowing the CH1 signal into the delay line driver. D107 and D108 are forward-biased, preventing the CH2 signal from reaching the delay line driver. For CH2 mode, the reverse is true.

For DUAL mode, both channels are displayed as follows: Below a sweep speed of 0.5 ms/div, the IC104 output switches at a 200 kHz rate. This chops the viewable trace into 5-microsecond segments which are alternately switched between Channel 1 and Channel 2 to provide dual trade. The chopping signal (clock pulse) that switches IC104 comes from an oscillator formed by gates IC4A and IC4B, and coupled through IC4C. For sweep speeds greater than or equal to 0.5 ms/div, the IC104 output switches state after every sweep, therefore alternating the 1 and 2 vertical signals for display. Thus, Channel 1 is viewed during one sweep, and Channel 2 is viewed during the next. The clock pulse to IC104 comes from IC4C.

When ADD mode is selected, the signals from both channels are added algebraically and then applied to the delay line driver. In this mode both the Q and $\overline{Q}$ outputs of IC104 must be high, which is done by setting both the set and reset lines of IC104 low.

TRIGGER CIRCUIT

The channel 1 signal is amplified by trigger amplifier Q107 and Q108 and is available at Q127 as a trigger source. Similarly, the Channel 2 signal is amplified by trigger amplifier Q117 and Q118 and is also available at Q127 as a trigger source. Mode logic IC103 determines which signal shall be selected as the trigger. In the CH 1 mode, diodes D117 and D120 are reverse biased which allows the signal from Channel 1 to reach Q127. Diodes D116 and D121 are forward biased and prevent the Channel 2 signal from reaching Q127. In the CH2 mode, the opposite is true. In the DUAL and ADD modes, an additional input to IC103 from one section of the SOURCE switch selects the Channel 2 signal if the SOURCE switch is set to CH2, but otherwise selects CH1.

The output of Q127 reaches the trigger coupling section via amplifiers Q24 and Q23. The SOURCE switch selects this signal in the CH1 or CH2 positions, an input from the EXT TRIG jack in the EXT position, or a rectified and filtered modulation envelope of the Channel 1 or 2 signal in the EXT 1/10 position. This signal is routed to FET amplifier Q13 through the COUPLING switch. The signal is direct coupled in the DC position, or capacitively coupled in the AC position. The signal is capacitively coupled through a low pass or high pass filter in the HF REJ or LF REJ positions respectively.

If the FIX-NORM switch is in the NORM position, the output of Q13 is DC-coupled to emitter follower Q14, which drives one input (pin 2) of op-amp IC5. The triggering LEVEL control sets a DC reference level into the other input of IC5 (pin 1) via Q15. IC5 acts as a high-gain differential amplifier or Schmitt trigger. When the signal on pin 2 exceeds the DC level on pin 1, the output changes states resulting in a sharp trigger. A trigger of the opposite polarity is developed when the pin 2 level again drops below the pin 1 reference level.

When the FIX-NORM switch is in the FIX position, the output of Q13 is capacitively coupled via Q14 to IC5, pin 2. The DC reference from the LEVEL control is disconnected and replaced by a DC voltage at the average of the sync trigger input, which is derived by detecting and filtering the signal in the input of Q15. This establishes the threshold reference for IC5 at the center of the waveform being used for triggering. Both polarities of the IC5 output are applied to the normal sync gates through Q16 and Q17, SLOPE switch S5 enables normal sync gate IC6B in the + position, allowing the Q16 signal to be gated through IC6C, IC7D, and IC7C.

When the VIDEO-NORM switch is in the VIDEO position, IC7C inhibits the normal sync signals and allows the video sync circuits (Q18, thru Q11) to supply the sweep trigger. The SLOPE switch selects the + or – polarity output of IC5 as the input to Q18, Q19, and Q20. At sweep times of 0.5 s to 0.1 ms/div, Q22 and Q21 are turned on, which connects capacitor C58 into the coupling circuit between Q19 and Q20. This capacitor shunts the short-duration horizontal sync pulses and allows the longer-duration vertical sync pulses to reach Q20. These slower sweep times are used for viewing vertical frames of fields of video. At sweep times of 50 μs to 0.2 μs/div, Q21 and Q22 are turned off and C58 is disconnected. This allows the horizontal sync pulses to reach Q20. These faster sweep times are used for viewing horizontal lines of video.

The trigger pulse output of IC7C is coupled through inverters IC1D and IC1C to the clock input of sweep control multivibrator IC2. This signal synchronizes the sweep to the waveform being used as the trigger source. In the absence of triggering, no sweep is normally developed. However, if PULL AUTO switch S4 is closed, Q7 is enabled and IC2 will free run in the absence of trigger signal. Transistors Q4, Q5, and Q6 detect the presence of trigger signal and inhibit Q7 when a trigger signal is present.

HORIZONTAL SWEEP

When a trigger pulse is received at the clock input or the reset input of IC2, the Q output (pin 8) goes low. This allows the horizontal ramp integrator to begin the sweep. The integrator consists of Q11, Q12 and the precision sweep timing resistors and capacitors. The sweep speed is determined by the RC time constant of the timing resistors and capacitors set by the SWEEP TIME/DIV control, S2.

The output of the integrator, a decreasing linear ramp, is fed through transistors Q9 and Q10, and then to the horizontal amplifier section, Q24-Q32, which drives the horizontal deflection plates. Another output of the sweep integrator, giving an increasing linear ramp, is fed to the threshold input of sweep holdoff timer IC3 (pin 6). When the decreasing ramp voltage has swept the scope trace to the right-hand limit of the sweep cycle on the CRT, the corresponding increasing ramp voltage reaches the threshold setting of IC3. This causes the output of IC3 (pin 3) to go low, which sets the Q output of the sweep control flip-flop, IC2, high. A high at the Q output turns on transistor Q8, which discharges the integrating capacitor and resets the sweep back to the left-hand sweep limit. Simultaneously with the Q output going high, the $\overline{Q}$ output of IC2 goes low, which sends a high out of the blanking control gate (IC4 pin 11). This turns the trace intensity down, so you cannot see it being reset to the left side of the CRT.

CIRCUIT DESCRIPTION

The sweep holdoff time delay capacitor connected to IC3 pin 2 is discharging through R25 into IC3 pin 7, which went low when threshold was reached at IC3 pin 6. When the holdoff time delay cap has discharged to less than 1.6 volts, the timer output, IC3 pin 3, is triggered high. This arms IC2 for the next trigger pulse, coming either from the clock line input (pin 12) or from the reset input when Q6 of the AUTO TRIGGERING circuit is turned on. Along with pin 3, pin 7 of IC3 also goes high and allows the holdoff time delay capacitor to charge up again. The length of the sweep holdoff is determined by the capacitor tied to IC3 pin 2, and the optimum value for each sweep speed is automatically set by the SWEEP TIME/DIV control.

During X-Y operation, set by the SWEEP TIME/DIV switch, the CH2 trigger amplifier output is fed to the horizontal amplifier via Q26 and Q28. In this mode, the CH2 signal controls the horizontal position of the CRT trace.

BLANKING AND INTENSITY CONTROL

The DC voltage on the intensity grid (pin 4 of the CRT) sets the intensity of the oscilloscope trace. A square wave signal is pulled off the secondary of the high voltage oscillator transformer T301 and amplified by Q302. The peak-to-peak limits of this square wave are determined by D306, D307, D309, and the intensity and blanking control circuitry Q303, Q304, Q305, and Q313. The square wave is AC-coupled into peak detector diodes D304 and D305. The negative peak of the square wave sets the DC voltage on the intensity grid. The more negative this voltage goes, the less the intensity. Intensity Adj., VR302, sets the maximum intensity of the trace. The front panel INTENSITY control VR201 adjusts the trace intensity during normal operation by controlling Q303.

The blanking pulse, which turns the trace intensity down during its return to the left-hand side of the CRT after each sweep, and which keeps the trace off prior to the beginning of a sweep, is generated by sweep control flip-flop IC2 and routed through blanking gates IC4C and IC4D. Blanking pulses during the chopping mode of dual-trace operation also come from blanking gates IC4C and IC4D, which are driven by dual-trace chopping oscillator IC4A and IC4B.

Intensity modulation, or the Z-axis signal, is provided by Q306, which DC-couples the Z-axis input jack to the intensity control circuit.

POWER SUPPLIES

The power supply voltages are fully regulated, and a DC-to-DC converter provides a regulated 5.2 kV accelerating potential to the CRT.

+15 Volt Supply

One output of the 14-volt secondary of the power transformer is rectified by diode bridge D319 to become unregulated +15 volts. This is also the source for the +10 volts, +5 volt, and high voltage supplies.

+10 Volt Supply

The unregulated +15 volt supply is regulated to +10 volts by Q308, Q315, and Q316.

+5 Volt Supply

The regulated +10 volt output is regulated to +5 volts by Q307 and Q314.

–8 Volt Supply

The other output of the 14-volt secondary of the power transformer is also rectified by diode bridge D319 and regulated to –8 volts by IC301A and Q309.

+120 Volt and +108.5 Volt Supplies

The 120-volt secondary of the power transformer is rectified by diode bridge D320 and regulated by IC301B and Q310 to +120 volts. Zener diode D318 drops part of the power supply output to a regulated +108.5 volts.

High Voltage Supply

The +15 volt supply drives a DC-to-DC converter consisting of Q301, Q311, Q312, and T301. Transformer T301 and driver Q301 form an oscillator. Regulation is achieved by feedback transistors Q302, Q311 and Q312. The secondary voltage of T301 is rectified and filtered as +4 kV for the anode of the CRT, –1.3 kV for the cathode, and high voltage for the focus grid. The filaments of the CRT are driven by a secondary of T301, floated at cathode potential.

MAINTENANCE

TRACE ROTATION ADJUSTMENT

Strong magnetic fields, present in many locations where an oscilloscope may be used, may cause the trace to be tilted. The degree of tilt may vary as the scope is moved from on location to another. The TRACE ROTATION control provides an electrically adjustable offset to compensate for trace tilt. Perform the adjustment as follows.

1. Set oscilloscope controls to produce a horizontal trace with no input signal (triggering MODE switch in AUTO).
2. Use POSITION controls as required to position the trace along a horizontal line of the graticule scale.
3. Adjust TRACE ROTATION so trace is parallel with the reference line on the graticule scale.

REMOVING THE CASE

The case is removed in two sections.

The top section can be lifted off after removing seven Phillips-head screws from the top and sides of the case.

The bottom section can be lifted off after removing four Phillips-head screws from the bottom of the case.

WARNING

1. The following instructions are for use by qualified personnel only. To avoid electrical shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.
2. High voltage up to 5000 VDC is present when the oscilloscope is operating. Line voltage (120 or 240 VAC) is present on the power transformer, on-off switch, fuse holder, and line voltage selector assembly any time the oscilloscope is connected to an AC power source, even if turned off. Always observe caution when the housing is removed from the unit. Contacting exposed high voltage could result in fatal electric shock.

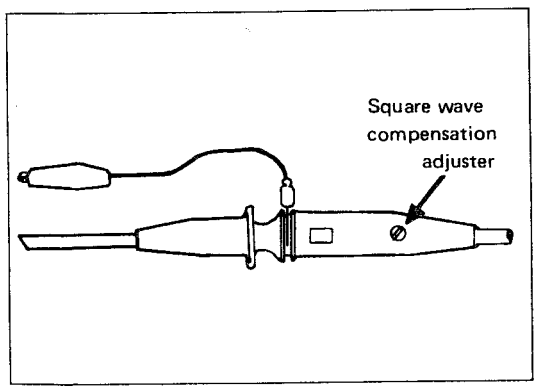


Fig. 3 **Probe compensation adjuster**

AC VOLTAGE CONVERSION

When operating the unit on voltage other than 240 V, set the AC voltage selector switch to 100 V, 117 V or 220 V according to your local AC voltage. The voltage selector switch is local on the rear panel of the unit as indicated by the arrow mark. When operating on 100 V or 117 V, remove the 0.3A fuse and replace it with one rate at 0.7A.

PROBE COMPENSATION

Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with Channel 1 and Channel 2 respectively. Probe compensation should be readjusted whenever a probe from a different oscilloscope is used, or the Channel 1 and 2 probes are interchanged.

1. Connect probes to both INPUT jacks. Connect ground clip of probes to oscilloscope ground terminal and tough tips of both probes to CAL 1 kHz 0.5 V p-p terminal.
2. Select single trace operation of Channel 1, then Channel 2, for steps 3 and 4.
3. Set oscilloscope controls to display 3 or 4 cycles of CAL square wave at 5 or 6 div amplitude.
4. Adjust compensation trimmer on probe for optimum square wave waveshape (minimum overshoot, rounding off, and tilt).

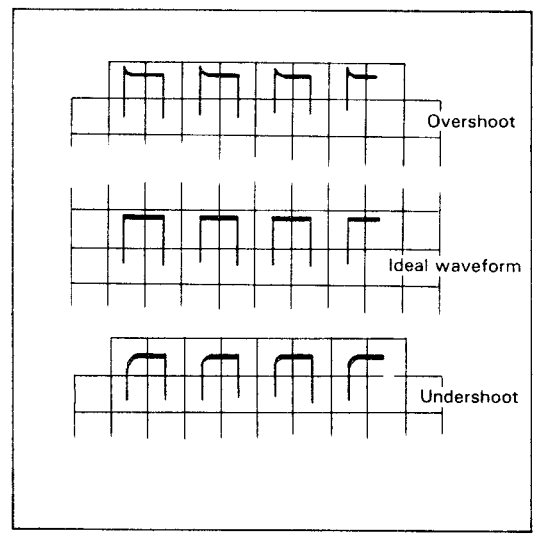


Fig. 4 **Probe compensation adjuster**

DISASSEMBLY

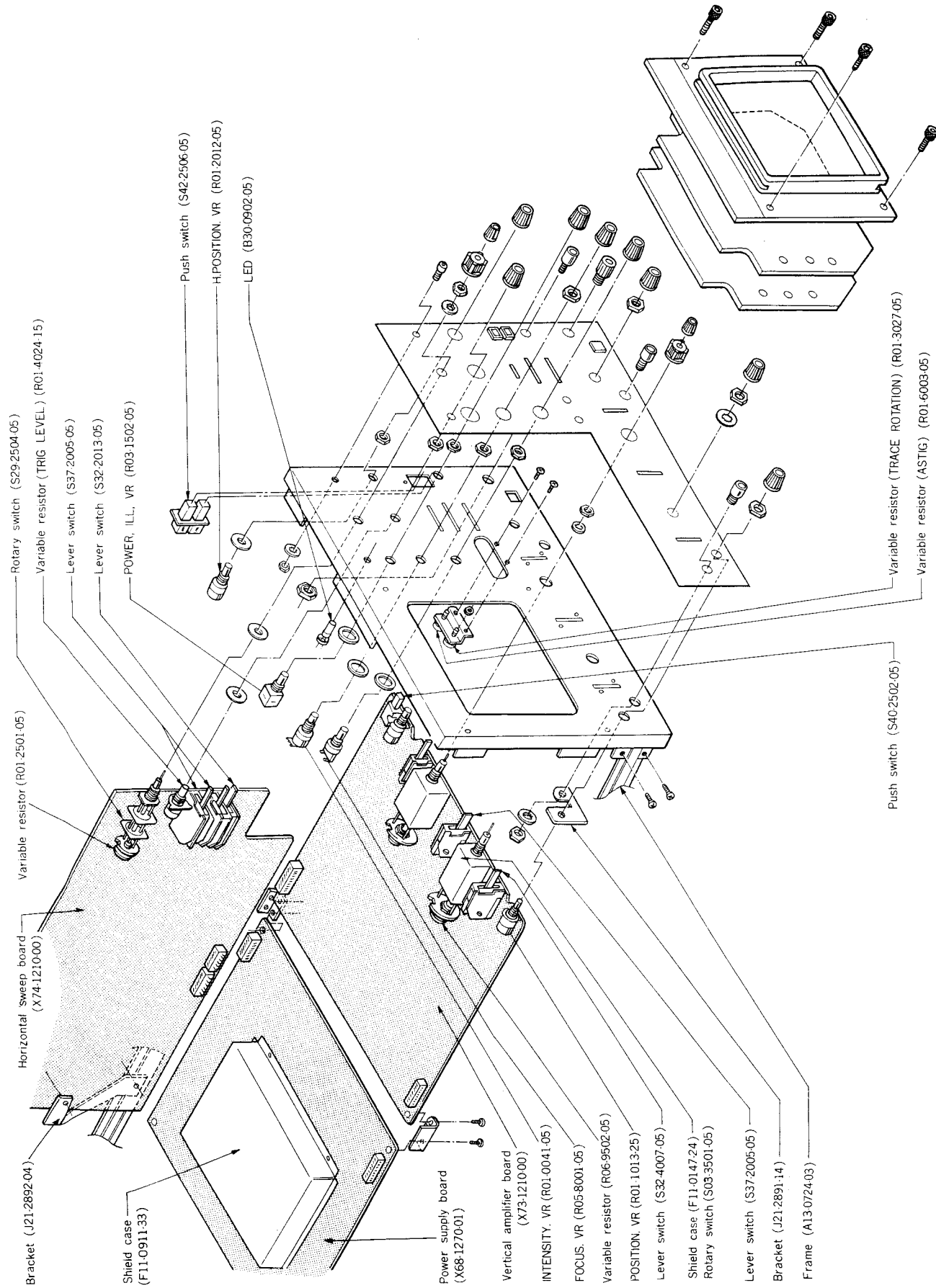


Fig. 5

DISASSEMBLY

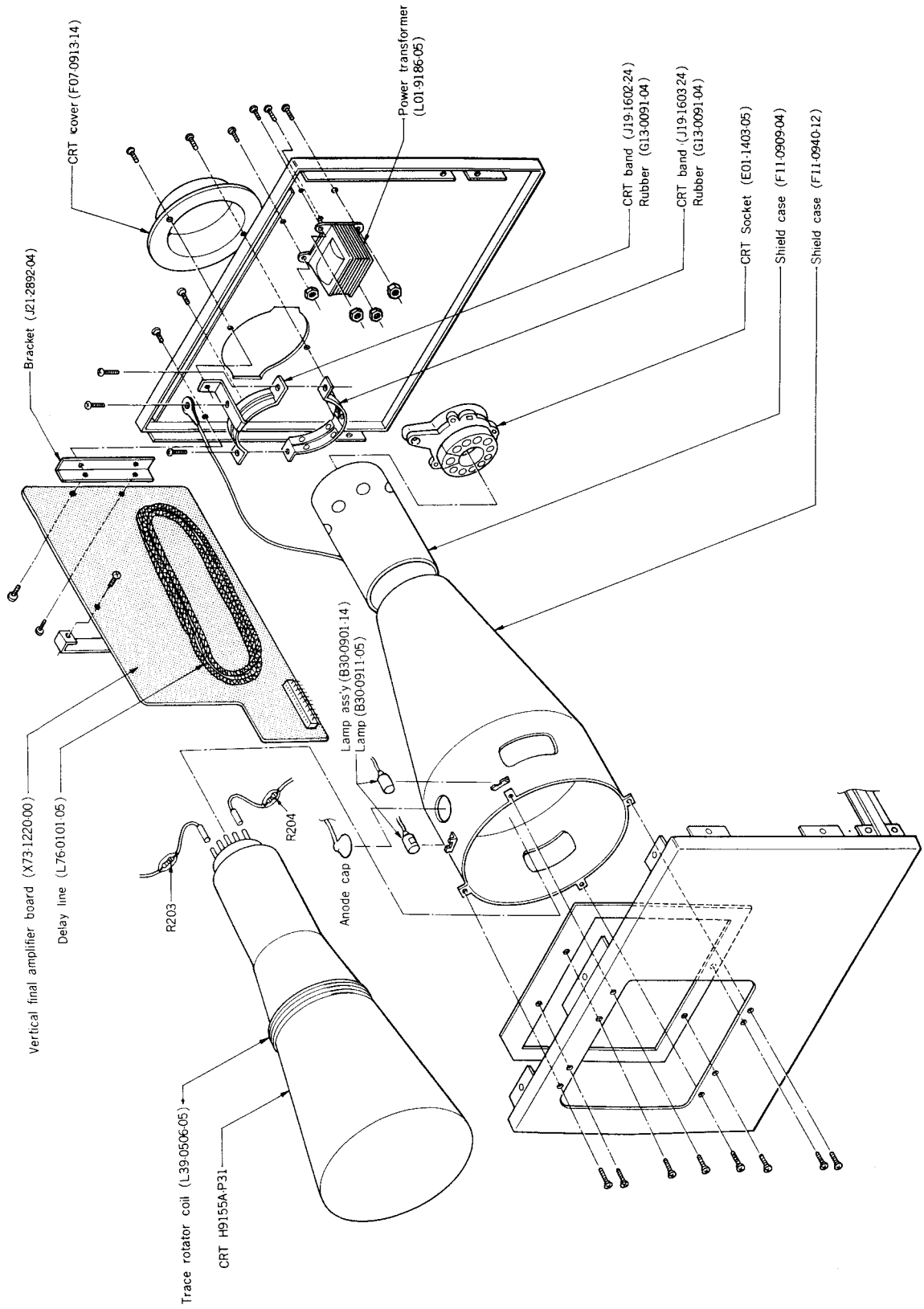


Fig. 6

ADJUSTMENT

The following points have been already adjusted.
However, observe the following notes before making readjustment:

1. Calibrating the power source voltage.
2. For adjustment, use a well-insulated flat-blade screwdriver.
3. For optimum adjustment, turn the power on and warm up the oscilloscope sufficiently before starting.
4. All adjustment should follow the following order. If this order reversed or only a partial adjustment is attempted, this may influence on the other part of the circuit.
5. Accurate measuring instruments should be employed.
6. Before making adjustment, set the operating controls unless otherwise specified as follows.

NAME OF KNOBS	POSITION
INTENSITY	3 o'clock
FOCUS	Optimum position
CH1, CH2 POSITION (both CH1 and CH2)	Mechanical center and push
◀▶ H. POSITION/PULL x 5MAG	Mechanical center and push
VARIABLE (both CH1 and CH2)	CAL
AC-GND-DC (both CH1 and CH2)	DC (GND at no signal)
MODE	CH1
CH2 POLARITY	NORM
SLOPE	+
COUPLING	AC
SOURCE	CH1(INT)
TRIG. LEVEL/PULL AUTO	Mechanical center and pull
FIX	NORM
VOLTS/DIV (both CH1 and CH2)	5 mV/DIV
SWEEP TIME/DIV	1 ms/DIV
VARIABLE (SWEEP)	CAL

POWER AND CRT CIRCUIT ADJUSTMENTS

+108.5 V, adjustment and check

1. Connect a DC voltmeter to measure the voltage at the pin 8 of P306 with respect to the chassis.
2. Adjust VR304 for a +108.5 V reading on the meter.

−1.3 kV adjustment

1. Connect a DC voltmeter to measure the voltage at the pin 9 of P301 with respect to the chassis.
2. Adjust VR303 for a −1.3 kV ±1% reading on the meter.

FOCUS and ASTIG adjustments

1. Set SWEEP TIME/DIV control to X-Y position and CH1 and CH2, AC-GND-DC switches to the GND. This will produce a spot on the screen.
2. With INTENSITY control set about mid-range, adjust both FOCUS and ASTIG on the front panel for the sharpest, roundest spot.
   Do not readjust the ASTIG control after this step.

INTENSITY adjustment

1. Set TRIG. MODE switch to AUTO to display a trace.
2. Adjust VR302 so that the trace disappears when INTENSITY control setting is reduced to the 8:30 o'clock position.

Blanking adjustment

1. Set SWEEP TIME/DIV control to 0.2 μs and TRIG. MODE switch to AUTO to display a trace.
2. Adjust TC301 until the start point of the trace is the same in thickness as the other.

Pattern distortion adjustment

1. Apply 1 kHz sine wave signal to CH1 input and 100 kHz sine wave signal to CH2 input.
2. Set SWEEP TIME/DIV control to X-Y position.
3. Adjust VR301 so that the waveform (Fig. 7-a, or Fig. 7-b) on the screen is as shown in Fig. 7-c.

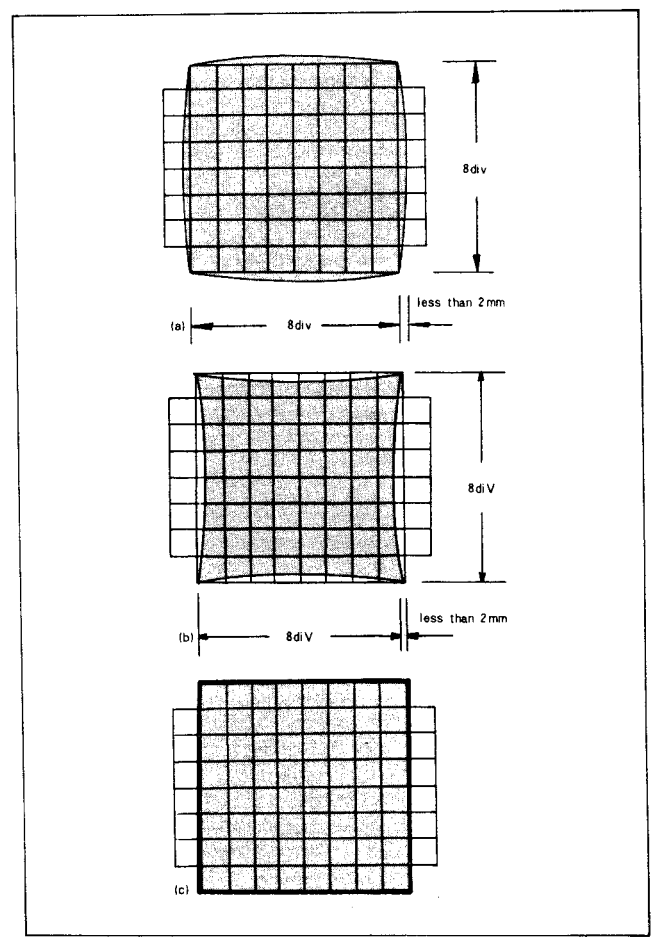


Fig. 7

ADJUSTMENT

Check of CRT centering

1. Short test terminal P401 to P402 (vertical final amplifier board).
2. Pull the PULL AUTO knob to display a trace.
3. Check the trace to center the trace vertically.

VERTICAL AXIS CIRCUIT ADJUSTMENT

VARI. ATT. BAL. and STEP ATT. BAL. adjustments

1. Set scope control for a single horizontal trace on CH1 with CH1 AC-GND-DC switch set to GND.
2. Rotate CH1 variable control from maximum clockwise to maximum counterclockwise, while observing the trace.
3. If the trace moves vertically, adjust VR101 (VARI. ATT. BAL.) for minimum or zero movement when performing step 2.
4. Rotate CH1 VOLTS/DIV switch through the 5 mV, 10 mV and 20 mV position while observing the trace.
5. If the trace moves vertically, adjust VR103 (STEP ATT. BAL.) for minimum or zero vertical movement when performing step 4.
6. Repeat the entire procedure for CH2, adjusting VR106 for VARIABLE balance and VR108 (VOLTS/DIV) step balance.

Note:
After adjusting VARI., be sure adjust STEP.

CH2 INVERT POLARITY and ▲▼ POSITION adjustments

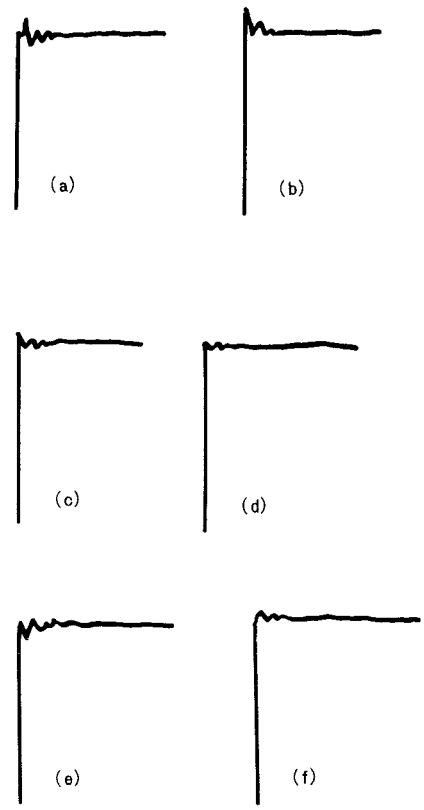
1. Set CH2 AC-GND-DC switch to GND, MODE switch to CH2, and SWEEP TIME/DIV control to 1 ms. Also, set TRIG. AUTO switch to AUTO.
2. Next, adjust VR112 to make sure that the trace does not shift when the CH2 POLARITY push button switch is set in PUSH position (INV) (▬).
3. Set CH2 and CH1 ▲▼ POSITION controls to these mechanical center and MODE switch to DUAL.
4. Adjust VR402 and VR105 so that traces are overlapped in the center of the scale.

Vertical gain adjustment

1. Set CH1 VOLTS/DIV control to 5 mV and VARIABLE control to CAL.
2. Apply a calibrated 1 kHz 20 mV peak-to-peak square wave signal to CH1. Set oscilloscope controls to display a square wave on the CRT screen.
3. Adjust VR401 for exactly 4 divisions amplitude on the CRT screen.
4. Repeat step 2 and 3 for CH2, adjusting VR110.

100 kHz square wave compensation

1. Set MODE switch to CH2 and SOURCE switch to CH2.
2. Apply 100 kHz square wave signal through a 50Ω terminator to CH2 input terminal and adjust the vertical amplitude to 6 divisions on the CRT screen.
3. Rotate SWEEP TIME/DIV control from 2 μs to 0.2 μs. Adjust TC401 thru TC404 and VR403 thru VR405 in the order (a to f) shown in the illustration below, to obtain the optimum waveform at the rising portion of the square wave.
4. Repeat the entire procedure for CH1, adjusting TC113.



1. Adjust VR404 to obtain flat mid range.
2. Adjust TC403 to obtain flat mid and high ranges.
3. Adjust TC402 to obtain maximum overshoot.
4. Adjust VR405 and VR403 to obtain minimum overshoot.
5. Adjust TC401 to obtain flat high range.
6. Adjust TC404 to obtain minimum overshoot.
7. Adjust TC402 to obtain flat high range.

Fig. 8

ADJUSTMENT

1 kHz square wave compensation

1. Set MODE switch to CH1 and SOURCE switch to CH1.
2. Apply 1 kHz square wave signal and set SWEEP TIME/DIV control to 0.1 ms.
3. Rotate VOLTS/DIV control to 50 mV, 0.5 V and 5 V and adjust the vertical amplitude to 6 divisions on the CRT screen.
4. Adjust TC101 (10:1), TC103 (100:1) and TC105 (1000:1) to obtain the optimum waveform at the rising portion of the square wave in each setting of VOLTS/DIV control.
5. Repeat the entire procedure for CH2, adjusting TC106, TC108 and TC110

Input capacity adjustment

1. Connect a "Q" meter to measure the input capacity at CH2 input and make sure that the input capacity is 23 pF ±3 pF.
2. Rotate VOLTS/DIV control to 50 mV (10:1), 0.5 V (100:1) and 5 V (1000:1), adjusting TC107, TC109 and TC112 to make sure that the input capacity at each position is the same as that at the 5 mV (1/1) position.
3. Repeat the entire procedure for CH1, adjusting TC102, TC104 and TC111.

HORIZONTAL AXIS CIRCUIT ADJUSTMENT

Sweep time and sweep length adjustments

1. Set SWEEP TIME/DIV control to 1 ms and apply 1 ms marker signal to CH1 input.
2. Adjust VR15 so that the 10 visible marker occupy exactly 9 divisions of horizontal deflection as shown in Fig. 9.
3. Next, adjust VR6 for a total sweep length of 10½ divisions.

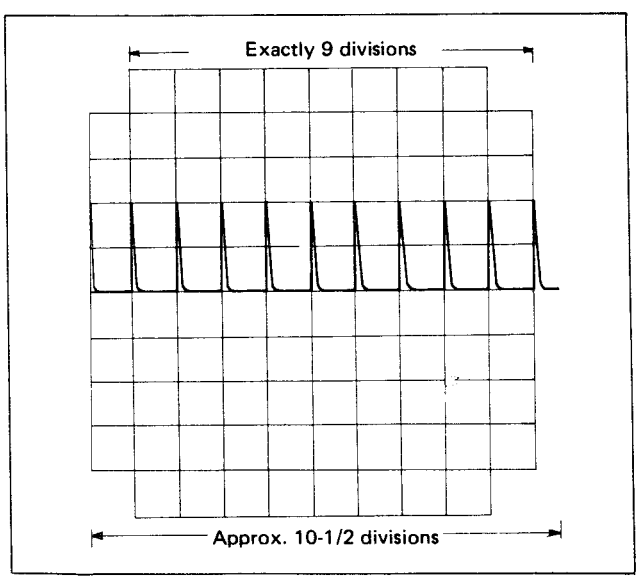


Fig. 9

MAG centering and MAG gain adjustments

1. With SWEEP TIME/DIV control to 1 ms, apply 1 ms marker signal to CH1 input.
2. Pull X5 MAG knob to magnify a trace and adjust VR18 so that the center of the wave corresponds to the Y-axis on the graticule scale and the marker that is one division apart in normal operation is exactly 5 divisions apart in X5 magnification operation.
3. Push X5 MAG knob and adjust VR13 so that the center of the trace corresponds to Y-axis on the graticule scale.
4. Next, set SWEEP TIME/DIV control to 0.2 ms.
5. With a 0.1 ms marker signal applied to CH1 input. Pull X5 MAG knob and adjust VR16 until the center of the 3 waves corresponds to the Y-axis on the graticule scale.

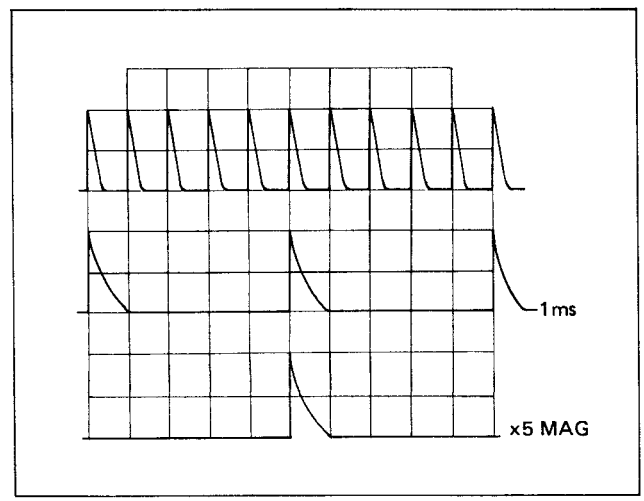


Fig. 10

◄► H. POSITION adjustment

1. With SWEEP TIME/DIV control set to 0.2 ms, apply 1 ms marker signal to CH1 to display 3 pulses on the CRT screen.
2. Next, set ◄► H. POSITION control to its mechanical center, and adjust VR16 until the center of the 3 pulses corresponds to the Y-axis on the graticule scale.

1 μs, 0.5 μs and 0.2 μs range adjustments

1. Set SWEEP TIME/DIV control to 1 μs, 0.5 μs and 0.2 μs while applying the corresponding marker signal (1 μs, 0.5 μs and 0.2 μs) to display 11 waves on the CRT screen.
2. Adjust TC1, TC2 and VR5 to duplicate the conditions shown in Fig. 9.

ADJUSTMENT

Linearity adjustment

1. Using X5 magnification, set SWEEP TIME/DIV control to 20 μs and apply 250 kHz sine wave signal to CH1 input.
2. Adjust TC3 if needed for good sweep linearity, so that the trace starts at the left edge of the graticule scale and the wave starting point is obtained as shown in Fig. 11.
3. Next, set SWEEP TIME/DIV control to 0.2 μs.
4. Apply 25 MHz sine wave signal to CH1 input to display a 6 divisions vertical amplitude wave.
5. Adjust ◄► H. POSITION so that trace starts at the left edge of the graticule scale when X5 MAG knob is pulled.
6. Adjust TC4 to set the spacing of waveform.

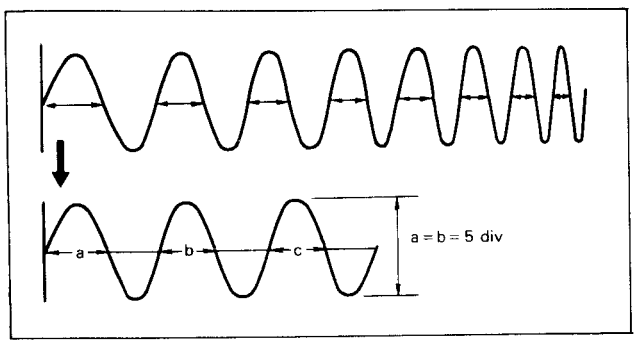


Fig. 11

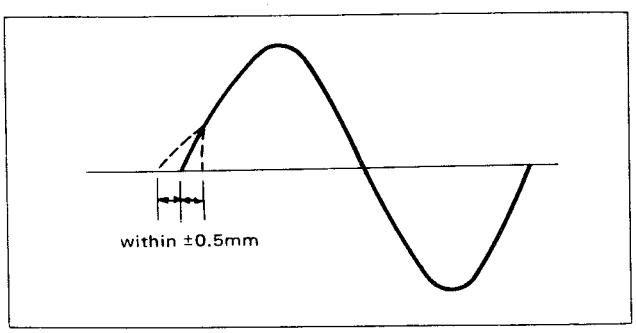


Fig. 12

X POSITION adjustment

1. Set CH2 position control to its mechanical center.
2. Set CH2 AC-GND-DC switch to GND.
3. Set SWEEP TIME/DIV switch to X-Y. A dot should appear on the CRT screen.
4. Adjust VR14 to center the dot horizontally on screen.

X gain adjustment

1. Set SWEEP TIME/DIV control to X-Y and CH2 VOLTS/DIV control to 5 mV.
2. Apply 1 kHz, 20 mV square wave to CH2 input and adjust VR111 for exactly 4 divisions horizontal deflection.

SYNC ADJUSTMENT

OFF-SET adjustment

1. Set TRIG LEVEL knob to its mechanical center and short the shorting terminals P14 and P15. Then, connect a calibrated oscilloscope (sensitivity: 0.2 V/div, AC-GND-DC: DC)
2. Adjust VR10 so that the voltage on the P13 is not varied when SLOPE knob is set to "+" and "—" positions.

TRIG LEVEL center adjustment

1. Set TRIG LEVEL control to its mechanical center.
2. Adjust VR7 so that the voltage on the P13 does not change when the shorting pins P14 and P15 are removed.

"+" and "—" TRIG adjustment

1. Set TRIG LEVEL control to its mechanical center. Apply 1 kHz sine wave signal to CH1 to display a 6 divisions vertical amplitude waveform.
2. Reduce the amplitude gradually and adjust VR12 so that the signal is triggered below 0.3 div.
3. Repeat the entire procedure for the "—" TRIG., adjusting VR11.
4. Check that the starting point remains the same when the SLOPE switch is set to the "+" and "—" positions.

FIX adjustment

1. Set TRIG LEVEL control to its mechanical center and push FIX switch.
2. With FIX switch held in the (▬) position, adjust VR9 so that the signal is triggered beolw 0.3 div when SLOPE switch is set to the "+" and "—" positions.

CH2 DC COUPLING adjustment

1. Set MODE switch to CH2.
2. Apply 1 kHz sine wave signal to CH2 to display a 6 divisions vertical amplitude waveform to the screen.
3. Set VR19 to its mechanical center and adjust VR13 so that the waveform starting point is not changed when COUPLING switch changes from AC to DC position. If this adjustment is not possible with VR13, use VR13 and VR19 alternately.

CH1 DC COUPLING adjustment

1. Set MODE switch to DUAL and COUPLING switch to DC.
2. Apply 1 kHz sine wave signal to CH1 and CH2 inputs to display a 6 divisions vertical amplitude waveform on the scope.
3. Adjust VR113 so that the waveform starting points of CH1 and CH2 are the same.

ADJUSTMENT

CALIBRATING VOLTAGE ADJUSTMENT

1. Connect out of CAL⎍⎍1 kHz, 0.1 Vp-p terminal to frequency counter and check the frequency to 1 kHz indication on frequency counter and adjust VR3.
2. Connect output of CAL⎍⎍1 kHz, 0.1 Vp-p terminal for CH1 indication on frequency counter to CH1 input and set oscilloscope controls to display one cycle of squre wave.
3. Adjust VR2 so that the square wave is symmetrical, that is, so that positive and negative portions of the trace are equal in length.
4. The CH1 attenuator must be previously calibrated as prescribed in this manual to perform this step. Set CH1 VOLTS/DIV control to 0.1 V and VARIABLE control to CAL. Adjust VR1 for 5 divisions amplitude.

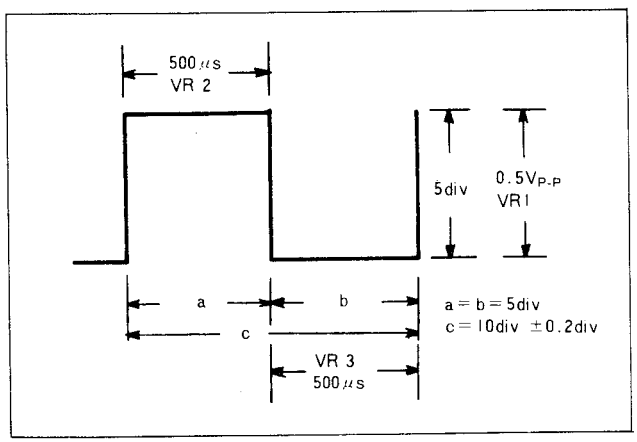


Fig. 13 CAL Amplitude and Time Adjustments

PERFORMANCE TESTS

After calibration adjustments are completed, the following tests will check non-adjustable circuits to confirm that oscilloscope operation meets all specifications.
If unsatisfactory performance is indicated, service and repair is required.

Vertical and Horizontal Positioning

1. With CH1 and CH2 POSITION controls at mechanical center (12 o'clock), each trace should be approximately centered vertically. Turning each POSITION control fully clockwise should move trace up at least 4 divisions from center, fully counterclockwise should move trace down at least 4 divisions from center.
2. Turning POSITION control fully clockwise should move trace at least 4 divisions right from centered position, fully counterclockwise should move trace at least 4 divisions left from centered position.

Band width

1. Apply 100 kHz sine wave and adjust for 6 divisions amplitude on the screen. Keeping the signal level constant, gradually increase the frequency to 30 MHz. Amplitude should roll off gradually with no dips or peak; at 30 MHz amplitude should be at least 4.2 divisions.
   The signal generator used for this must have an amplitude flatness within 3% from 100 kHz to 30 MHz, or the signal amplitude may be measured on an RF voltmeter that has 3% or less variation in accuracy from 100 kHz to 30 MHz, and the signal generator amplitude adjusted for a constant reading on the RF voltmeter.
2. Check CH1 and CH2 independently.

Rise time

Rise time is defined as the period of time required for a pulse to rise from the 10% level to the 90% level of transition Fig. 14. The Model CS-1570A oscilloscope should have a rise time of 11.7 nsec or less. The pulse or square wave used as the signal source must have a faster rise than the oscilloscope for this measurement, or the rise time of the signal, rather than the rise time of the oscilloscope will be displayed.
Use a signal source with a rise time of 8 nsec or less.
Terminate the signal source in 50Ω to prevent rising.

1. Apply a 1 MHz square wave, or pulse with 500 μs pulse width, and rise time of 8 ns or less.
2. Set ocilloscope SWEEP TIME/DIV switch to its fastest setting of 0.2 μs/div, sweep VARIABLE to CAL, and pull the X5 MAG knob. This produces a sweep time of 100 ns/div.
3. Adjust for 6 divisions amplitude as shown in Fig14.
4. Locate the 10% and 90% amplitude points, and measure the time between those 2 points, which should be 24 ns or less (approx. ¼ division)
5. Measure CH1 and CH2 independently.

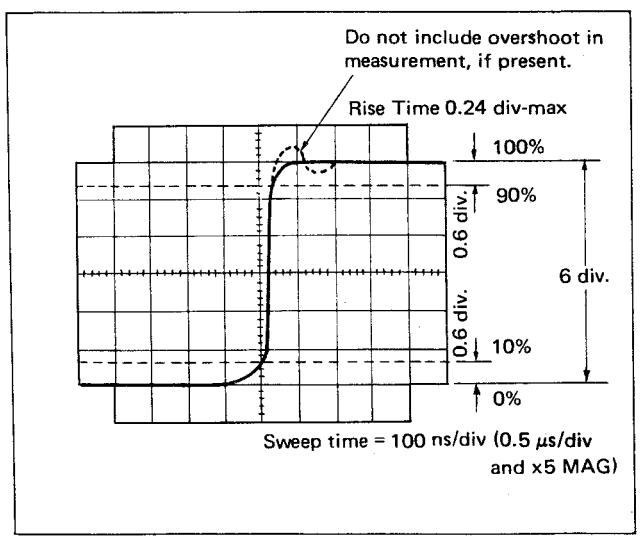


Fig. 14 Rise Time Measurement

ADJUSTMENT

Sync

1. Using internal sync (SOURCE switch in INT position), triggering should be possible from any signal source that produce a vertical deflection of no more than 1 division. Check performance with SYNC switch in both VIDEO and NORM positions, and with SLOPE switch in both + and – positions.
   In VIDEO position, frequency of sync signal should be below 1000 Hz for FRAME sweep speeds (1 ms/div and slower)
2. Using external sync (SOURCE switch in EXT 1 position and sine wave applied to EXT TRIG jack), triggering should be possible with any 10 Hz to 30 MHz signal of no more than 1 volt peak-to-peak.

Vertical Linearity

1. Apply a 25 MHz sine wave and set oscilloscope controls to display waveform of 2 divisions amplitude in the center of screen. Using the POSITION control to move the display to the top and bottom of the screen, there should be no more than 0.1 division change in amplitude.
2. Check CH1 and CH2 independently.

Intensity Modulation

1. Set SWEEP TIME/DIV control to 1 ms position, and apply 1 kHz square wave to Z axis input jack. To sync sweep, simultaneously apply square wave to EXT TRIG jack and use EXT 1 sync.
2. Starting with square wave amplitude of approx. 10 volts, note intensity modulation (alternate bright and dim intervals on trace). Decrease amplitude of square wave to lowest level that gives clearly visible intensity modulation.
   Use low intensity to avoid masking effect.
   Intensity modulation should be visible at square wave levels of less than 5 volts peak-to peak.

Hum Check

1. Set CH1 and CH2 AC-GND-DC switch to GND.
2. Hum should be less than 0.1 division on all sweep time and attenuator ranges.
3. Trace line shift should be within 0.3 division when AC-GND-DC switch is changed from one position to another.

Crosstalk Check

1. Apply 10 volt, 1 kHz sine wave to CH1 and set oscilloscope control to display a 5 divisions amplitude.
2. Set CH2 AC-GND-DC switch to GND. The CH2 VOLTS/DIV control may be left in any position.
   Set MODE switch to DUAL so that both channels may be observed.
3. Rotate CH1 VOLTS/DIV control from the 2 V position to the 10 mV thru 50 mV positions (overdrive CH1). Observe CH2 for crosstalk. Crosstalk amplitude should be less than 1 division.
4. Repeat step 1 thru 3 for CH2 to CH1 crosstalk.

TEST EQUIPMENT REQUIRED

* Sine & Square Wave Generator; 20 Hz to 1 MHz, constant voltage over tuning range.
* Sine Wave Generator; 1 MHz to 15 MHz, constant voltage output over tuning range.
* DC Power Supply; variable over 10 to 15 VDC @ 2 amperes.
* AC Voltmeter; 1% accuracy @ 1 kHz, 100 mV to 10 V ranges.
* Time Marker Generator; marker outputs, 2 nanoseconds to 0.5 second.
* Frequency Counter; 1% or better accuracy to 15 MHz.
* VOM with high impedance (1000 MΩ); high voltage prove.

ADJUSTMENT

Function of adjustment of each board

Vertical amplifier board (X73-1210-00)	
VR101	CH1 VARI. ATT. BAL adj.
103	CH1 STEP ATT. BAL adj.
105	CH1 ▲▼ POSITION adj.
106	CH2 VARI. ATT. BAL adj.
108	CH2 STEP ATT. BAL adj.
110	CH2 gain adj.
111	X-gain adj.
112	CH2 INV. polarity adj.
113	CH1 DC COUPLING adj.
TC 101	CH1 10:1 square waveform compensation
102	CH1 10:1 input capacity adj.
103	CH1 100:1 square waveform compensation
104	CH1 100:1 input capacity adj.
105	CH1 1000:1 square waveform compensation
106	CH2 10:1 square waveform compensation
107	CH2 10:1 input capacity adj.
108	CH2 100:1 square waveform compensation
109	CH2 100:1 input capacity adj.
110	CH2 1000:1 square waveform compensation
111	CH1 1000:1 input capacity adj.
112	CH2 1000:1 input capacity adj.
113	CH1 high frequency adj.

Horizontal sweep board (X74-1210-00)	
VR 1	CAL voltage adj.
2	CAL duty adj.
3	CAL frequency adj.
5	0.2μs sweep timing adj.
6	Sweep length adj.
7	TRIG LEVEL adj.
9	FIX level adj.
10	OFF-SET adj.
11	- SLOPE adj.
12	+SLOPE adj.
13	CH2 DC COUPLING adj.
14	X POSITION adj.
15	Sweep time adj. (1 ms)
16	◀▶ H-POSITION adj.
17	MAG centering adj.
18	MAG gain adj.
19	CH2 DC COUPLING adj.
TC 1	1μs–50μs sweep timing adj.
2	0.5μs sweep timing adj.
3	1μs–50μs sweep linearity adj.
4	0.5μs sweep linearity adj.

Power supply board (X68-1270-01)	
VR301	Pattern distortion adj.
302	INTENSITY adj.
303	– 1.3 kV adj.
304	+ 108.5 V adj.
TC 301	Blanking adj.

Vertical final amplifier board (X73-1220-00)	
VR401	CH1 gain adj.
402	CH2 ▲▼ POSITION adj.
403	High frequency response adj.
404	Mid frequency response adj.
405	High frequency response adj.
TC 401	High frequency response adj.
402	High frequency response adj.
403	Mid frequency response adj.
404	High frequency response adj.

ADJUSTMENT

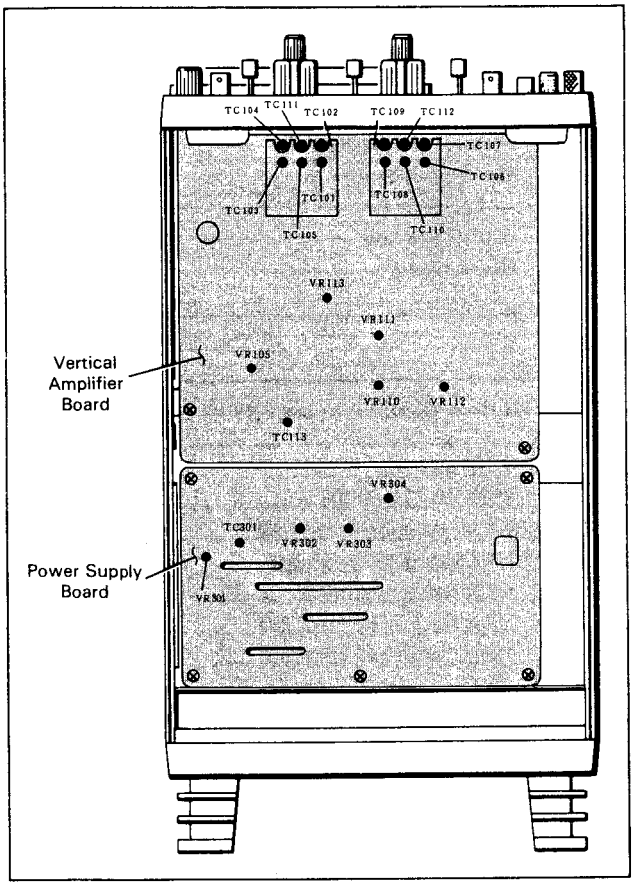


Fig. 15 Location of Adjustment, Bottom of Scope

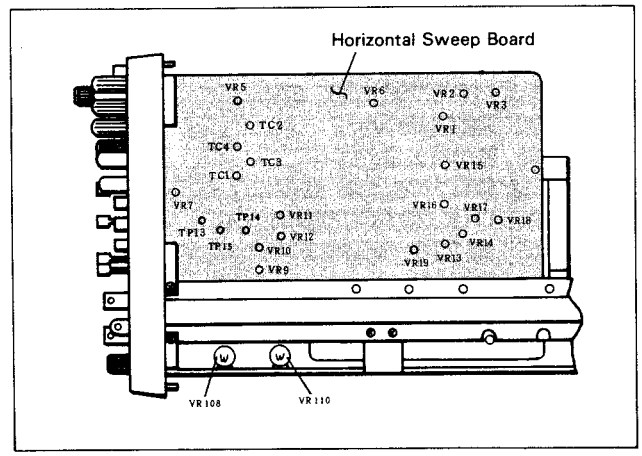


Fig. 16 Location of Adjustment, Right Side of Scope

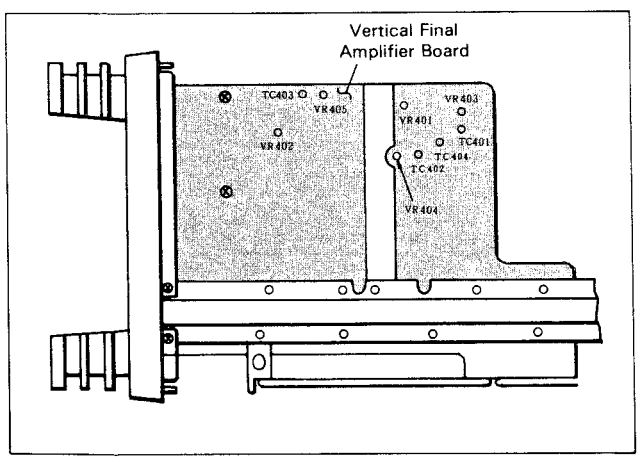
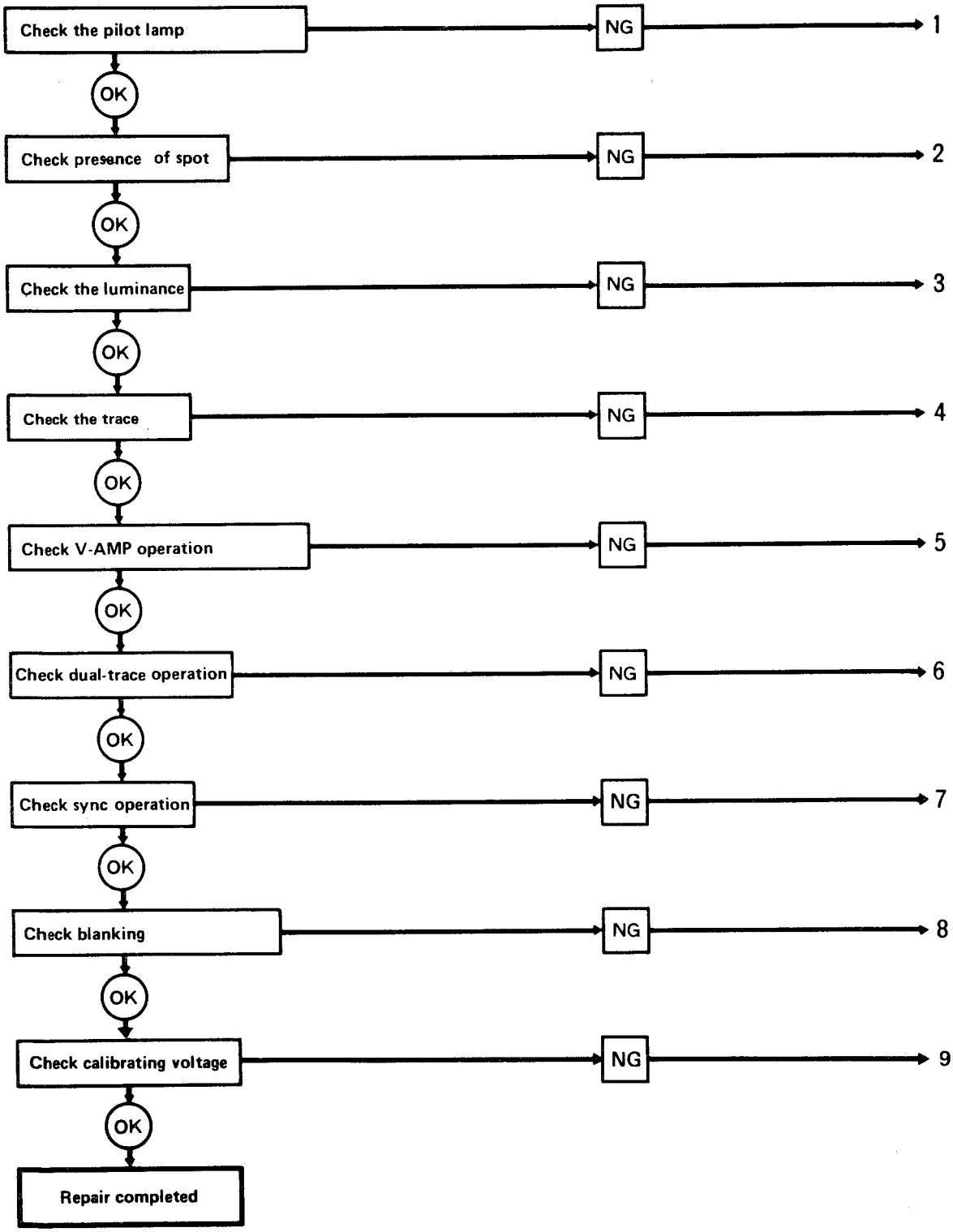


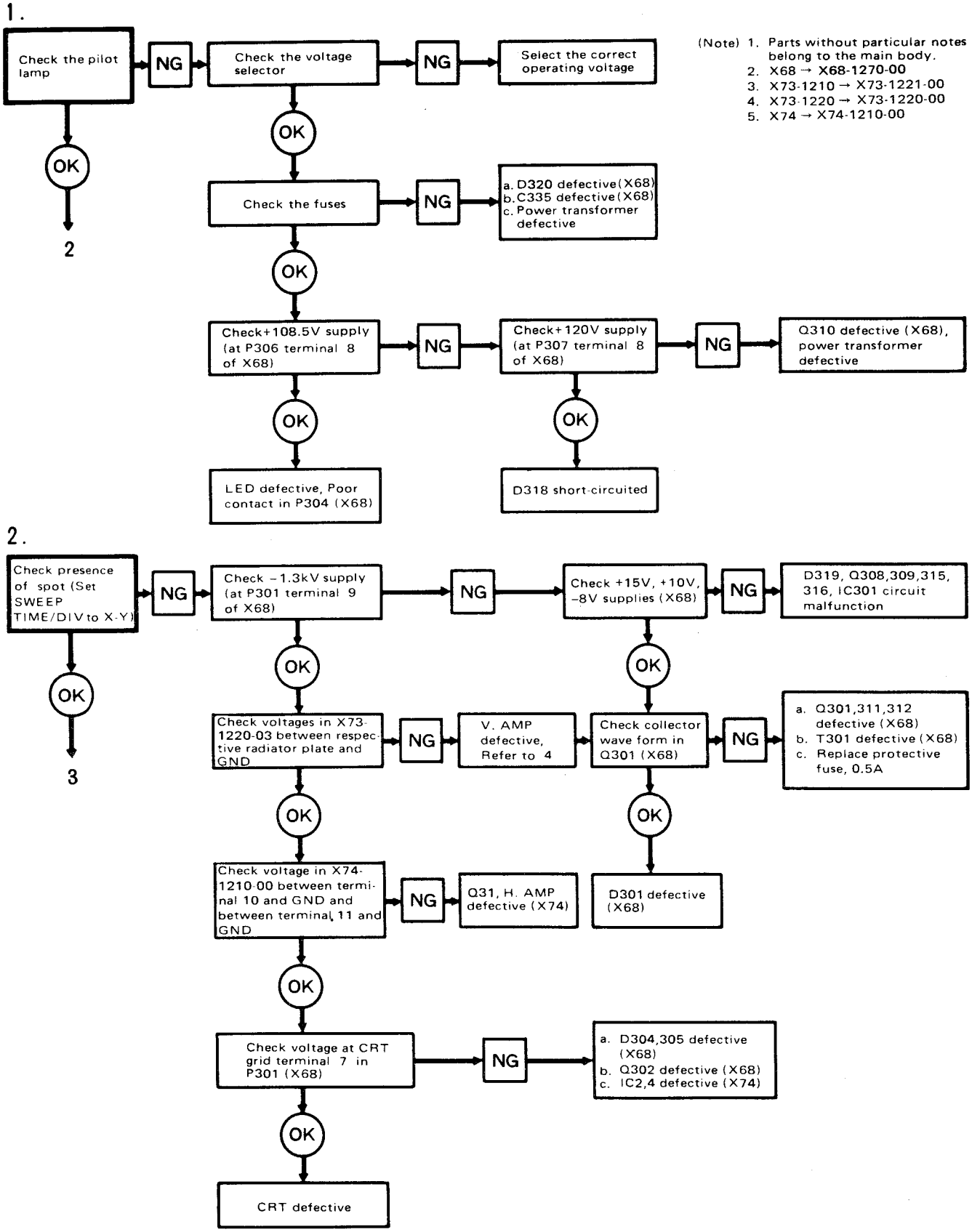
Fig. 17 Location of Adjustment, Left Side of Scope

TROUBLESHOOTING

TROUBLESHOOTING CHART



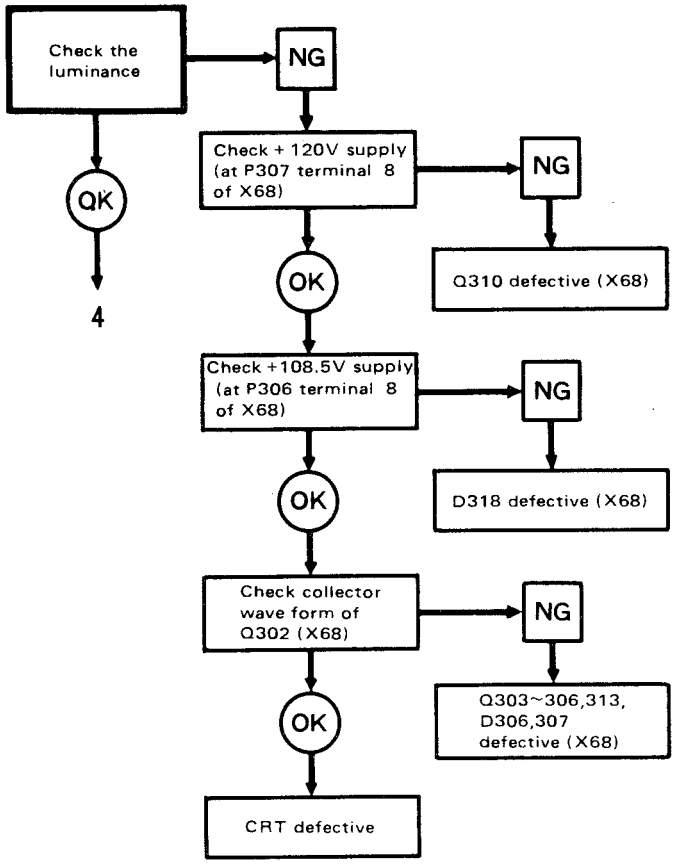
TROUBLESHOOTING



(Note) 1. Parts without particular notes belong to the main body.
2. X68 → X68-1270-00
3. X73-1210 → X73-1221-00
4. X73-1220 → X73-1220-00
5. X74 → X74-1210-00

TROUBLESHOOTING

3.



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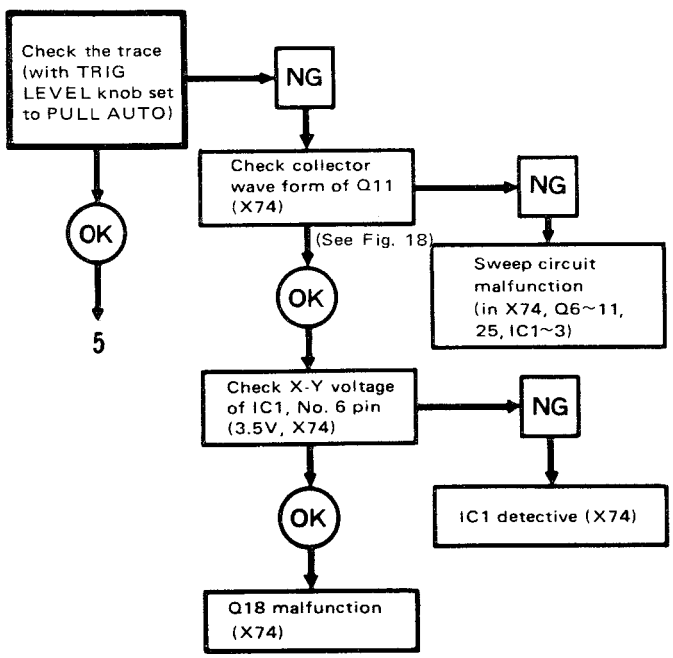
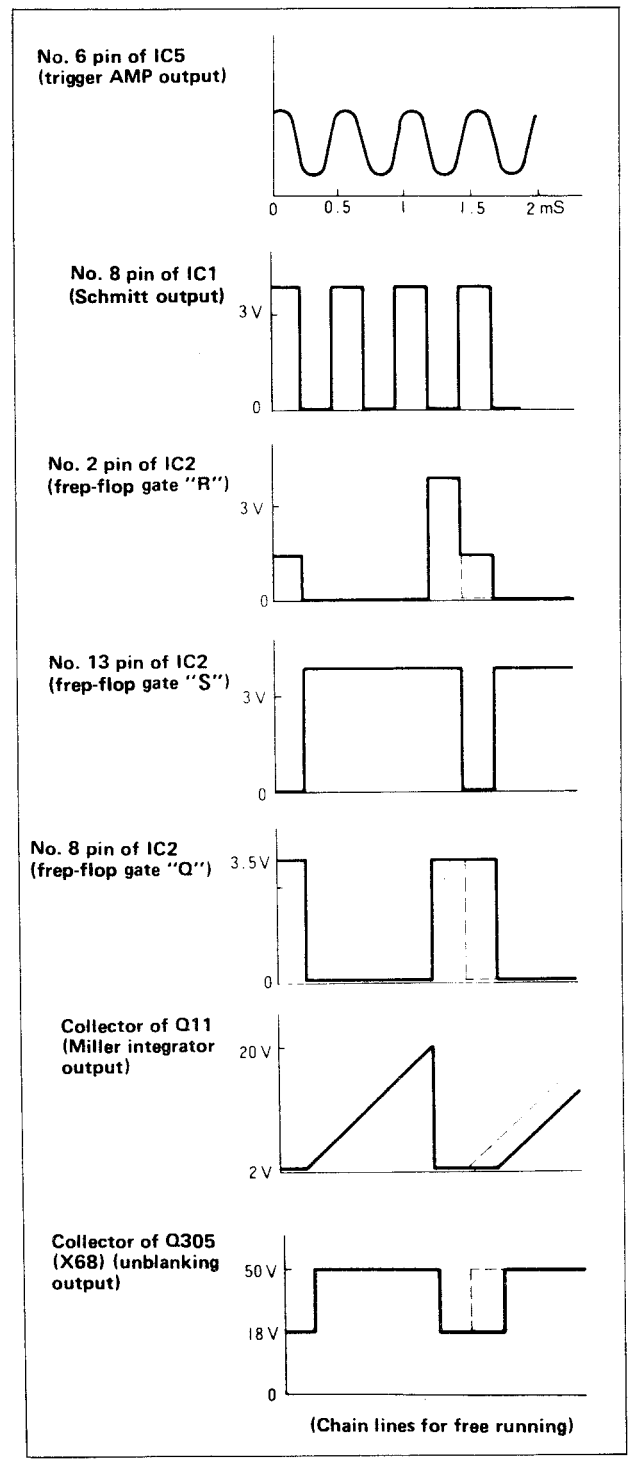
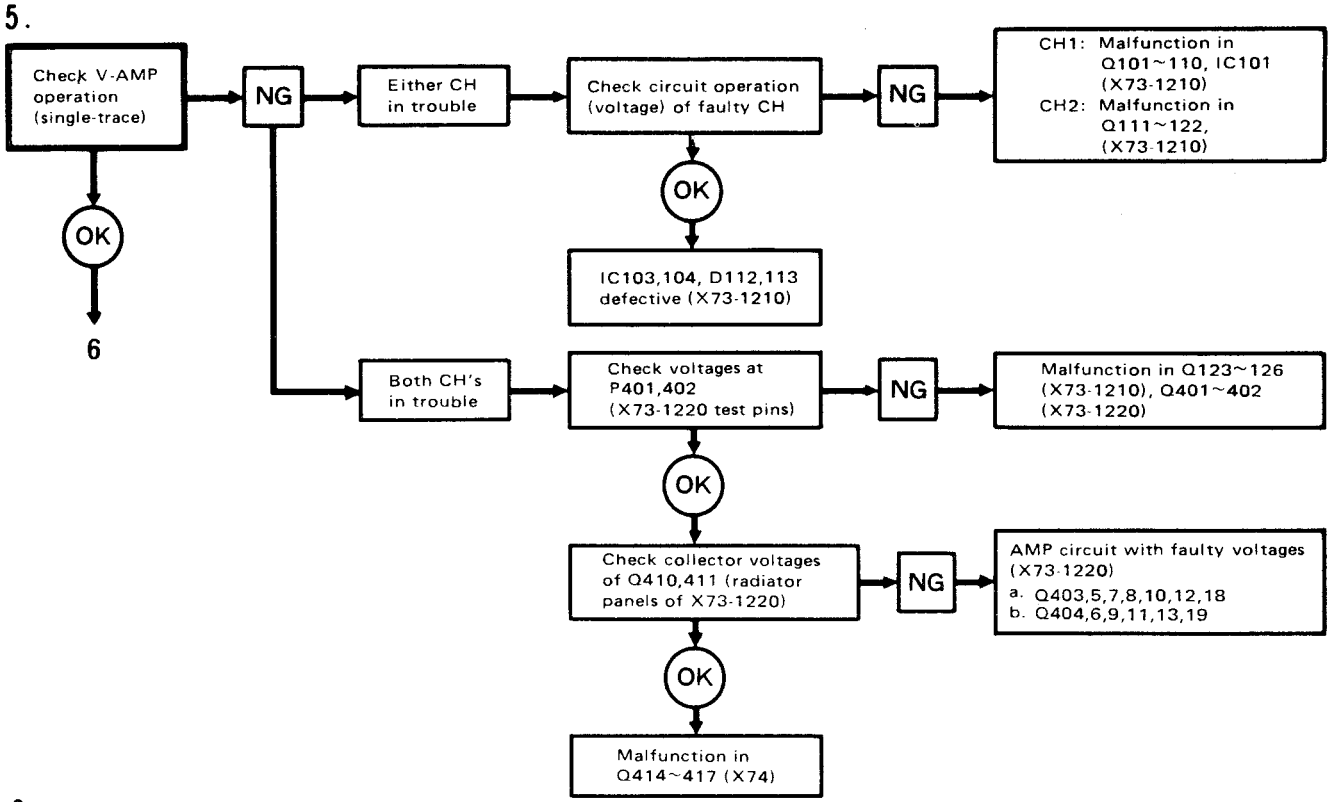


Fig. 18 Wave Form in SWEEP Circuit (X74-1210-00) (Input Signal 2kHz Sine Wave, SWEEP TIME 0.1mS/div)



TROUBLESHOOTING

5.



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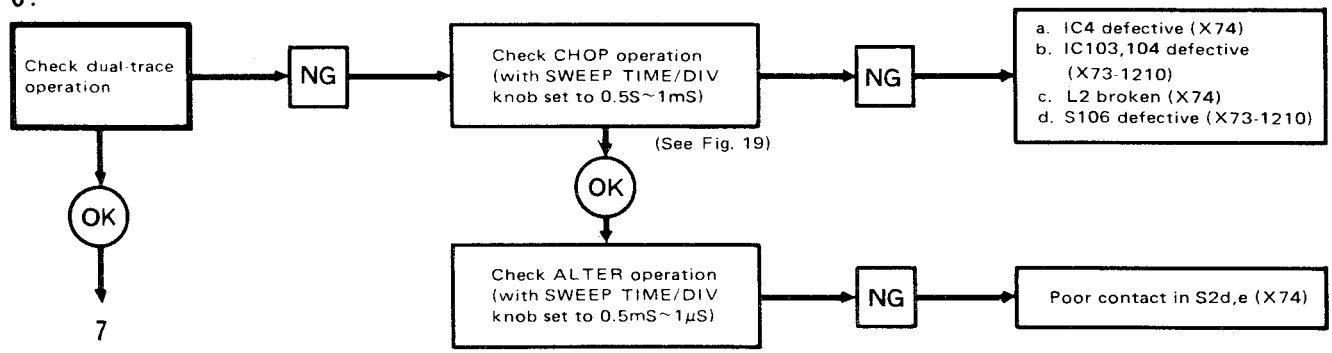


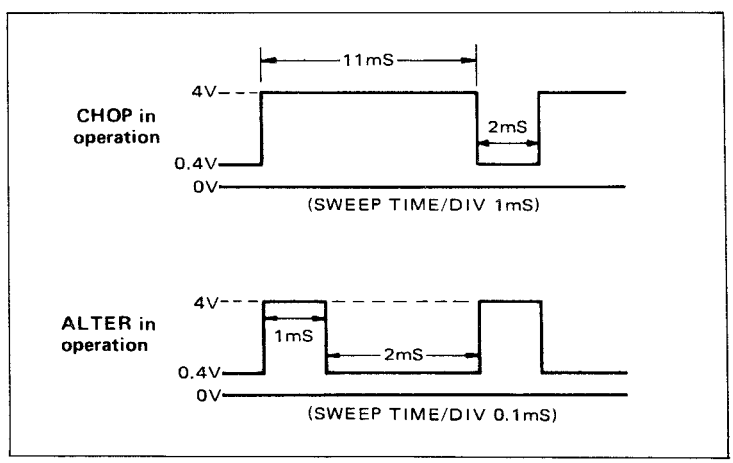
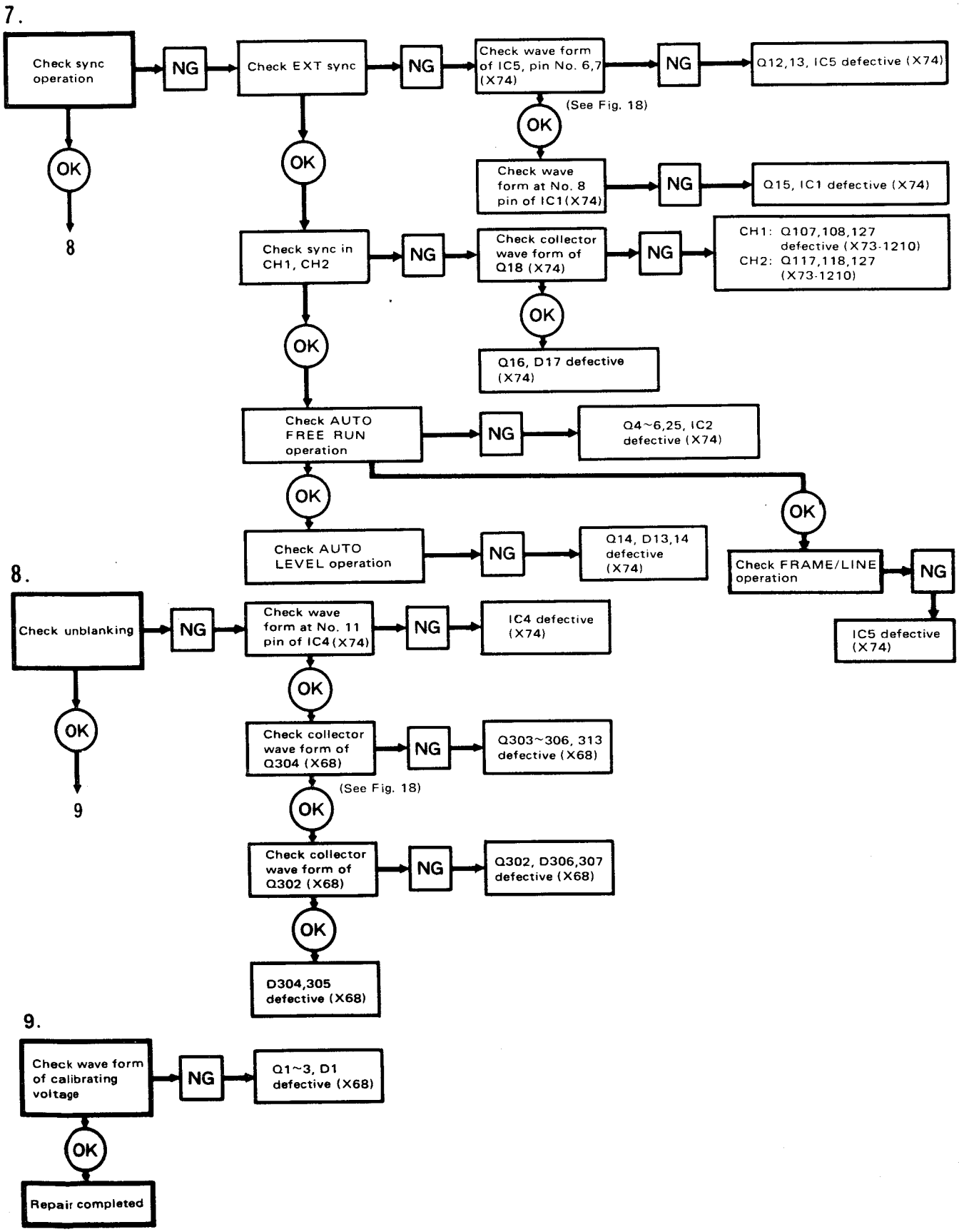


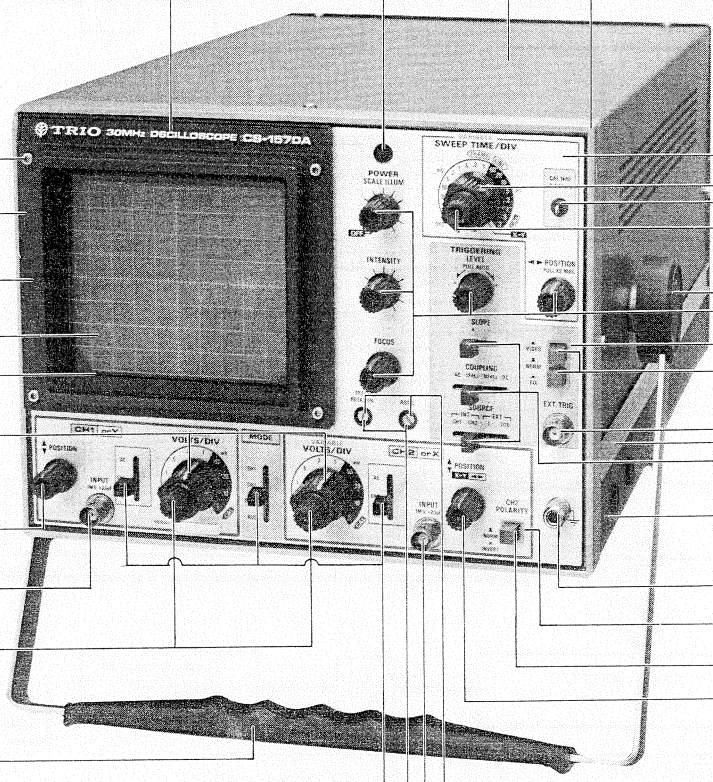
Fig. 19 J1 Clock Pulse Wave Forms at Terminal 5

TROUBLESHOOTING

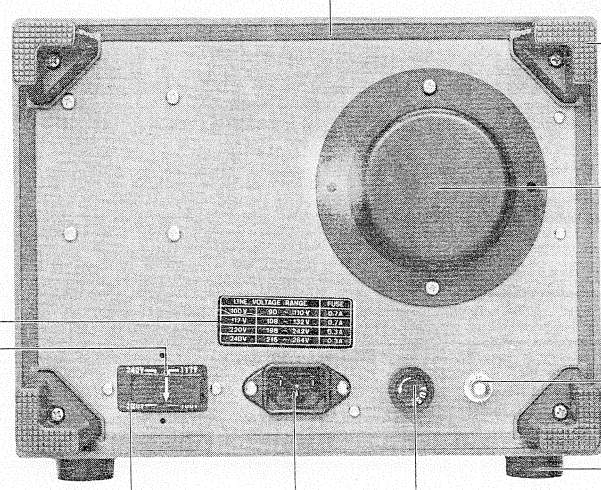


EXTERNAL VIEW

FRONT PANEL



REAR PANEL



PARTS LIST

MAIN CHASSIS

Ref. No.	Parts No.	Description
–	A01-0829-03	Case (Top)
–	A01-0835-13	Case (Bottom)
–	A13-0724-03	Frame ×2
–	A20-2738-12	Die casting panel
–	A21-0852-12	Decorative panel
–	A23-1615-32	Rear panel
–	B07-0703-04	Push escutcheon (round, grey) ×2
–	B07-0704-04	Push escutcheon (rectangular, light grey)
–	B07-0705-12	Rear escutcheon
–	B19-0704-04	Filter
–	B20-0903-14	Graticule
–	B30-0901-05	Lamp ass'y
–	B30-0911-05	Lamp ×2
–	B30-0902-05	LED
–	B40-0765-14	Name plate (Serial)
–	B41-0701-14	Name plate (Voltage power indication)
–	B50-2891-10	Instruction manual
–	B07-0707-03	Bezel frame
–	B40-2762-03	Name plate (Model)
–	E01-1403-05	CRT socket
–	E03-0201-05	Power connector
–	E04-0251-05	BNC receptacle ×4
–	E21-0654-04	CAL terminal
–	E21-0657-04	Metal terminal
–	E23-0505-04	Grounding plate ×2
–	E23-0513-05	Grounding lug
–	E30-1818-05	JIS power cord
–	E30-0554-15	Lead wire with connector
–	E31-0659-05	Lead wire with connector
–	E31-0507-15	Lead wire with connector
–	E31-0660-05	Lead wire with connector (×2)
–	E31-0511-15	Lead wire with connector
–	E31-0514-05	Lead wire with connector
–	E31-0684-05	Lead wire with connector
–	E31-0712-05	Lead wire with connector
–	E31-0532-05	Lead wire with connector (1P)
–	E31-0533-05	Lead wire with connector
–	E31-0723-05	Lead wire with connector
–	E31-0664-15	Lead wire with connector
–	F05-7011-05	Fuse (0.7A) ×2
–	F05-3011-05	Fuse (0.3A) ×3
–	F07-0908-14	Handle cover ×2
–	F07-0913-14	CRT cover
–	F10-1525-24	Shield plate (For bezel)
–	F11-0940-12	Shield (For CRT)
–	F11-0909-04	Shield (For CRT)
–	G02-0603-14	Spring (For handle) ×2
–	G13-0091-04	Rubber (For CRT mounting) ×2
–	J02-0089-05	Rubber leg ×4
–	J10-0069-03	Bezel ass'y
–	J10-0052-12	Bezel
–	J13-0033-15	Fuse holder
–	J19-1602-24	Band (For CRT)
–	J19-1603-24	Band (For CRT)
–	J21-2812-34	Bracket (For P.C. board)
–	J21-2813-34	Bracket (For P.C. board)
–	J21-2814-53	Bracket (For P.C. board)
–	J21-2815-34	Bracket (For P.C. board)
–	J21-2818-54	Bracket (For P.C. board)
–	J21-2891-14	Bracket (For variable resistor)
–	J21-2875-15	Mounting hardware (For handle) ×2
–	J21-2876-05	Mounting hardware (For handle) ×2
–	J42-0508-14	Mounting rubber (For lamp) ×2
–	K01-0507-05	Handle
–	K21-0819-03	Knob ×7
–	K21-0820-04	Knob ×3 (red)
–	K21-0822-14	Knob
–	K27-0501-04	Lever knob (black) ×3
–	K27-0502-04	Lever knob (grey) ×3
–	K27-0503-04	Push knob (rectangular blue)
–	L01-9186-05	Power transformer
–	L39-0506-05	Rotator coil
–	N08-0606-05	Hex socket head screw ×4
–	H01-2877-04	Packing case
–	H10-2807-02	Pad (formed styrene) ×2
–	H20-1701-24	Protection cover
–	H12-0522-04	Pad (carton)
–	W01-0503-04	Cord wrap
–		CRT, H9155A-P31 or E2729B31A
S202a,b,203	S42-2506-05	Push switch
VR201	R01-0041-05	Variable resistor 500ΩB (INTEN)
VR202	R01-2012-05	Variable resistor 5kΩB (H. POS)
VR203	R01-6003-05	Variable resistor 250kΩB (ASTIG)
VR204	R03-1502-05	Variable resistor (with SW) 1kΩC (ILL)
VR205	R05-8001-05	Variable resistor 3MΩB (FOCUS)
VR206	R01-3027-05	Variable resistor 10kΩB (TRACE ROT)
R203,204	RD14BB2E220J	Carbon resistor 22Ω ±5% 1/4W
–	X68-1270-01	Power supply board
–	X73-1210-00	Vertical amp. board
–	X73-1220-00	Vertical output amp. board
–	X74-1210-00	Horizontal sweep board
–	X77-1020-00	Voltage selector board

VERTICAL AMPLIFIER (X73-1210-00) ☆ on under side of p.c.board

Ref. No.	Parts No.	Description			
		RESISTOR			
R101	RD14BB2E 220J	Carbon	22Ω	±5%	1/4W
R102	RN14BK2H9003F	Metal film	900kΩ	±1%	1/2W
R103	RN14BK2E1113F	Metal film	111kΩ	±1%	1/4W
R104	RN14BK2H9903F	Metal film	990kΩ	±1%	1/2W
R105	RN14BK2E1012F	Metal film	10.1kΩ	±1%	1/4W
R106	RN14BK2E4021F	Metal film	4.02kΩ	±1%	1/4W
R107	RN14BK2H1004F	Metal film	1MΩ	±1%	1/2W
R108	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R109~116	RD14CB2E220J	Carbon	22Ω	±5%	1/4W
R117,118	RN14BK2E3901F	Metal film	3.9kΩ	±1%	1/4W
R119	RD14CB2E681J	Carbon	680Ω	±5%	1/4W
R120	RN14BK2E2701F	Metal film	2.7kΩ	±1%	1/4W
R121	RN14BK2E3301F	Metal film	3.3kΩ	±1%	1/4W
R122	RN14BK2E2201F	Metal film	2.2kΩ	±1%	1/4W
R123	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
R124	RN14BK2E1300F	Metal film	130Ω	±1%	1/4W
R126	RN14BK2E69R8F	Metal film	69.8Ω	±1%	1/4W
R127~129	RN14BK2E1000F	Metal film	100Ω	±1%	1/4W
R130	RN14BK2E10R0F	Metal film	10Ω	±1%	1/4W
R131,132	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R133,134	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R135	RN14BK2E1500F	Metal film	150Ω	±1%	1/4W
R136	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R137,138	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R139,140	RN14BK2E3901F	Metal film	3.9kΩ	±1%	1/4W
R141	RN14BK2E1200F	Metal film	120Ω	±1%	1/4W
R142,143	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R144,145	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R146~149	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R150	RD14BB2E560J	Carbon	56Ω	±5%	1/4W

PARTS LIST

Ref. No.	Parts No.	Description			
R151	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R152	RD14BB1E222J	Carbon	2.2kΩ	±5%	1/4W
R153,154	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R155,156	RN14BK2E5600F	Metal film	560Ω	±1%	1/4W
R157	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R158	RD14BB2E681J	Carbon	680Ω	±5%	1/4W
R159	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R160,161	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R162	RN14BK2H9003F	Metal film	900kΩ	±1%	1/2W
R163	RN14BK2E1113F	Metal film	111kΩ	±1%	1/4W
R164	RN14BK2H9903F	Metal film	990kΩ	±1%	1/2W
R165	RN14BK2E1012F	Metal film	10.1kΩ	±1%	1/4W
R166	RN14BK2E4021F	Metal film	4.02kΩ	±1%	1/4W
R167	RN14BK2H1004F	Metal film	1MΩ	±1%	1/2W
R168	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R169~176	RD14CB2E220J	Carbon	22Ω	±5%	1/4W
R177,178	RN14BK2E3901F	Metal film	3.9Ω	±1%	1/4W
R179	RD14CB2E681J	Carbon	680Ω	±5%	1/4W
R180	RN14BK2E2701F	Metal film	2.7kΩ	±1%	1/4W
R181	RN14BK2E3301F	Metal film	3.3kΩ	±1%	1/4W
R182	RN14BK2E2201F	Metal film	2.2kΩ	±1%	1/4W
R183	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
R184	RN14BK2E1300F	Metal film	130Ω	±1%	1/4W
R186	RN14BK2E69R8F	Metal film	69.8Ω	±1%	1/4W
R187~189	RN14BK2E1000F	Metal film	100Ω	±1%	1/4W
R190	RN14BK2E10R0F	Metal film	10Ω	±1%	1/4W
R191, R192	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R193,194	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R195	RN14BK2E1500F	Metal film	150Ω	±1%	1/4W
R196	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R197,198	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R199,200	RN14BK2E3901F	Metal film	3.9kΩ	±1%	1/4W
R201	RD14BB2E820J	Carbon	82Ω	±5%	1/4W
R202,203	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R204,205	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R206~209	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R210	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R211,212	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R213,214	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R215,216	RN14BK2E5600F	Metal film	560Ω	±1%	1/4W
R217,218	RD14BB2E391J	Carbon	390Ω	±5%	1/4W
R219,220	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R221	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R222	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R223	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R224,225	RN14BK2E2700F	Metal film	270Ω	±1%	1/4W
R226,227	RN14BK2E91R0F	Metal film	91Ω	±1%	1/4W
R228	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R229,230	RN14BK2E2201F	Metal film	2.2kΩ	±1%	1/4W
R232	RD14BB2E680J	Carbon	68Ω	±5%	1/4W
R233,234	RN14BK2E2001F	Metal film	2kΩ	±1%	1/4W
R235	RD14BB2E680J	Carbon	68Ω	±5%	1/4W
R239,240	RN14BK2H9963F	Metal film	996kΩ	±1%	1/2W
☆R243,244	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
VR101	R12-0508-05	Semi-fixed	330ΩB		
VR102	R06-9502-05	Variable with "VARI" switch	300ΩB		
VR103	R12-0501-05	Semi-fixed	100ΩB		
VR104	R01-1013-25	Variable with "POSITION" switch	1kΩB		
VR105	R12-1003-05	Semi-fixed	2.2kΩB		
VR106	R12-0508-05	Semi-fixed	330ΩB		
VR107	R06-9502-05	Variable with "VARI" switch	300ΩB		
VR108	R12-0501-05	Semi-fixed	100ΩB		
VR109	R01-1013-25	Variable with "POSITION" switch	1kΩB		
VR110,111	R12-0502-05	Semi-fixed	100ΩB		
VR112	R12-1003-05	Semi-fixed	2.2kΩB		
VR113	R12-2020-05	Semi-fixed	6.8kΩB		
CAPACITOR					
C101	C91-0501-05	Metalized film	0.047μF	±10%	
C103	CM93BD2A470J	Mica	47pF	±5%	
C104	CC45CH2H020D	Ceramic	2pF	±0.5pF	

Ref. No.	Parts No.	Description			
C105	CM93BD2A151J	Mica	150pF	±5%	
C106	C91-0502-05	Metalized film	0.01μF	±10%	
C107,108	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C110,112	CE04W1A101	Electrolytic	100μF	10WV	
C114	C91-0501-05	Metalized film	0.047μF	±10%	
C115	C91-0502-05	Metalized film	0.01μF	±10%	
C117	CM93BD2A470J	Mica	47pF	±5%	
C118	CC45CH2H020D	Ceramic	2pF	±0.5pF	
C119	CM93BD2A151J	Mica	150pF	±5%	
C120~122	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C123~126	CE04W1A101	Electrolytic	100μF	10WV	
C127	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C128	CE04W1C221	Electrolytic	220μF	16WV	
C129,130	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C131	CE04W1A101	Electrolytic	100μF	10WV	
C132	CC45CH1H150J	Ceramic	15pF	±5%	
C133	CC45CH1H220J	Ceramic	22pF	±5%	
C135	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C136	CC45CH1H121J	Ceramic	120pF	±5%	
C137	CC45CH1H150J	Ceramic	15pF	±5%	
C138	CC45CH1H220J	Ceramic	22pF	±5%	
C140	CC45CH1H050D	Ceramic	5pF	±0.5pF	
C141	CC45CH1H121J	Ceramic	120pF	±5%	
C142,143	CK45D1H103M	Ceramic	0.01μF	±20%	
C144	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
☆C145,146	CK45D1H103M	Ceramic	0.01μF	±20%	
C147	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C148	CM93BD2A331J	Mica	330pF	±5%	
C149,150	CC45CH2H020D	Ceramic	2pF	±0.5pF	
C151	CM93BD2A331J	Mica	330pF	±5%	
C154	CC45CH1H270J	Ceramic	27pF	±5%	
C155	CC45CH1H150J	Ceramic	15pF	±5%	
☆C156~160	CC45CH1H100D	Ceramic	10pF	±0.5pF	
TC101	C05-0065-05	Ceramic trimmer	6pF		
TC102	C05-0066-05	Ceramic trimmer	10pF		
TC103	C05-0065-05	Ceramic trimmer	6pF		
TC104	C05-0066-05	Ceramic trimmer	10pF		
TC105,106	C05-0065-05	Ceramic trimmer	6pF		
TC107	C05-0066-05	Ceramic trimmer	10pF		
TC108	C05-0065-05	Ceramic trimmer	6pF		
TC109	C05-0066-05	Ceramic trimmer	10pF		
TC110	C05-0065-05	Ceramic trimmer	6pF		
TC111,112	C05-0066-05	Ceramic trimmer	10pF		
TC113	C05-0401-05	Ceramic trimmer	20pF		
SEMICONDUCTOR					
D101~108		Diode, silicon, small signal	1S1587		
D109~121		Diode, silicon, small signal	1S1555		
D122,123		Diode, silicon, small signal	1S1587		
D124~127		Diode, germanium	1N60		
Q101		FET	2SK30A(O)		
Q102		Dual FET	2SK228T(1-2 or 1-3)		
Q103~106		Transistor, NPN silicon	2SC535(B)		
Q107,108		Transistor, PNP silicon	2SA838(C)		
Q109,110		Transistor, NPN silicon	2SC535(B)		
Q111		FET	2SK30A(O)		
Q112		Dual FET	2SK228T(1-2 or 1-3)		
Q113~116		Transistor, NPN silicon	2SC535(B)		
Q117,118		Transistor, PNP silicon	2SA838(C)		
Q119~122		Transistor, NPN silicon	2SC535(B)		
Q123,124		Transistor, PNP silicon	2SA844(D)		
Q125,126		Transistor, NPN silicon	2SC458(C)		
Q127		Transistor, PNP silicon	2SA844(D)		

PARTS LIST

Ref. No.	Parts No.	Description
IC101,102		IC, Linear HA1127
IC103		IC, Digital TD3400AP
IC104		IC, Digital TD3472AP
	MISCELLANEOUS	
–	E29-0503-05	Terminal ×2 (Fluorine)
–	E29-0504-05	Terminal ×10 (Fluorine)
J5	E31-0658-05	Lead wire with connector
P101	E40-0701-05	Connector 7P
–	E40-0802-05	Connector 8P
–	E33-0949-00	
–	F10-1510-04	Shield plate
–	F11-0147-24	Shield case
–	F11-0910-13	Shield case
–	J25-2806-83	Printed circuit board
L101,102	L40-2201-03	Ferri inductor 22μH
–	R92-0150-05	Jumper wire, resistor type
S101,102	S32-4007-05	Lever switch (for AC-GND-DC)
S103,104	S03-3501-05	Rotary switch
S105	S40-2502-05	Pushbutton switch
S106	S37-2005-05	Lever switch (for MODE)

VERTICAL FINAL AMPLIFIER (X73-1220-00)

☆ on under side of p.c.board

Ref. No.	Parts No.	Description			
	RESISTOR				
R401,402	RN14BK2E91R0F	Metal film	91Ω	±1%	1/4W
R403,404	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R405	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R406,407	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R408	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R409,410	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R411	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
R412,413	RD14BB2E391J	Carbon	390Ω	±5%	1/4W
R414~417	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R418,419	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R420,421	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R422,423	RN14BK2E4701F	Metal film	4.7kΩ	±1%	1/4W
R424,425	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
R426,427	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R428,429	RN14BK2E7502F	Metal film	75kΩ	±1%	1/4W
R430,431	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R432,433	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
R434,435	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R436,437	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R438,439	RD14BB2E100J	Carbon	10Ω	±5%	1/4W
☆R440,441	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R442,443	RD14BB2E681J	Carbon	680Ω	±5%	1/4W
R444~447	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R448,449	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R450,451	RD14BB2E222J	Carbon	2.2Ω	±5%	1/4W
R452	RD14BB2E681J	Carbon	680Ω	±5%	1/4W
R453	RD14BB2E181J	Carbon	180Ω	±5%	1/4W
R454	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R456	RD14BB2E681J	Carbon	680Ω	±5%	1/4W
R457	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R458	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R459,460	RD14BB2E393J	Carbon	39kΩ	±5%	1/4W
R461	RD14BB2E333J	Carbon	33kΩ	±5%	1/4W
R462,463	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R464,465	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R466	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R467	RD14BB2E303J	Carbon	30kΩ	±5%	1/4W
R471,472	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R474,475	RD14BB2E151J	Carbon	150Ω	±5%	1/4W

Ref. No.	Parts No.	Description			
VR401	R12-0511-05	Semi-fixed	220ΩB		
VR402	R12-3004-05	Semi-fixed	47kΩB		
VR403	R12-1002-05	Semi-fixed	1kΩB		
VR404	R12-5018-05	Semi-fixed	220kΩB		
VR405	R12-1002-05	Semi-fixed	1kΩB		
	CAPACITOR				
C401,402	C90-0298-05	Semi-conductor ceramic	0.1μF	+80% −20%	
C403	CE04W1A331Q	Electrolitic	330μF	10WV	
C405	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C406	CQ93M1H333K	Mylar	0.033μF	±10%	
C407	CK45B1H471K	Ceramic	470pF	±10%	
C408	CK45D1H103M	Ceramic	0.01μF	±20%	
C409	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C410	CC45CH1H150J	Ceramic	15pF	±0.5pF	
C411	CE04W1E221	Electrolytic	220μF	25WV	
C412	CE04W1C101	Electrolytic	100μF	16WV	
C413	C90-0298-05	Semi-conductor ceramic	0.1μF	+80% −20%	
C414	CE04W1C470	Electrolytic	47μF	16WV	
C415	CK45D1H103M	Ceramic	0.01μF	±20%	
C416	CK45D2H103M	Ceramic	0.01μF	±20%	
C417,418	CC45CH2H010D	Ceramic	1pF	±0.5pF	
C419,420	CK45D1H103M	Ceramic	0.01μF	±20%	
C421,422	CC45CH1H330J	Ceramic	33pF	±5%	
C423,424	CC45SL1H121J	Ceramic	120pF	±5%	
C425	CK45D1H103M	Ceramic	0.01μF	±20%	
C426,427	CK45D2H332M	Ceramic	3300pF	±20%	
C428,429	CK45D2H103M	Ceramic	0.01μF	±20%	
C430	C90-0298-05	Semi-conductor ceramic	0.1μF	+80% −20%	
C431	CK45D1H103M	Ceramic	0.01μF	±20%	
C432	C90-0298-05	Semi-conductor ceramic	0.1μF	+80% −20%	
C433	CE04W1A101	Electrolytic	100μF	10WV	
C434	CE04W1E221	Electrolytic	220μF	25WV	
C435	C90-0298-05	Semi-conductor ceramic	0.1μF	+80% −20%	
C436	CE04W1E101	Electrolytic	100μF	25WV	
C437	CC45SL1H820J	Ceramic	82pF	±5%	
C439	CC45SL1H221J	Ceramic	220pF	±5%	
☆C440	CC45CH1H010C	Ceramic	1pF	±0.25pF	
☆C441	CC45CH1H030C	Ceramic	3pF	±0.25pF	
TC401	C05-0401-05	Ceramic trimmer	20pF		
TC402,403	C05-0066-05	Ceramic trimmer	10pF		
TC404	C05-0401-05	Ceramic trimmer	20pF		
	SEMICONDUCTOR				
D401,402		Diode, silicon	1S1587		
D403		Diode, zener	WZ-130		
D404		Diode, zener	WZ-050		
D405,406		Diode, silicon	1S1555		
D407		Diode, zener	WZ-050		
D408,409		Diode, silicon	1S1587		
Q401~404		Transistor, NPN silicon	2SC535-(B)		
Q405~409		Transistor, NPN silicon	2SC458-(C)		
Q410,411		Transistor, NPN silicon	2SC1628-(Y)		
Q412,413		Transistor, PNP silicon	2SA818-(Y)		
Q414,415		FET	2SK19-(GR)		
Q416,417		Transistor, NPN silicon	2SC1047-(C)		
Q418,419		Transistor, NPN silicon	2SC458-(C)		
	MISCELLANEOUS				
–	E23-0047-04	Terminal			
–	E29-0504-05	Terminal (Teflon)			
–	E29-0505-05	Socket pin			
–	E40-0806-05	Connector			
–	F01-0821-04	Heat sink ×2			

PARTS LIST

Ref. No.	Parts No.	Description
—	J32-0122-04	Hexagon boss × 2
—	J25-2808-43	Printed circuit board
—	J21-2892-04	Bracket (P.C. board)
L401	L40-4701-03	Ferri-inductor 47μH
L402,403	L40-1092-02	Ferri-inductor 1μH
L404	L76-0101-05	Delay line
L406	L40-2201-03	Ferri-inductor 22μH
L407,408	L40-1091-41	Ferri-indutor 1μH
TH401 ~ 403		Thermistor (SDT-100)

HORIZONTAL SWEEP (X74-1210-00) ☆ on under side of p.c.board

Ref. No.	Parts No.	Description			
		RESISTOR			
R1	RD14BB2E562J	Carbon	5.6kΩ	±5%	1/4W
R2	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R3	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R4	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R5	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R6,7	RD14BB2E563J	Carbon	56kΩ	±5%	1/4W
R8	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R9	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R10	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R11	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R12	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R13	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R14	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R15	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R16,17	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R18	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R19	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R20	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R21	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R22	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R23,24	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R25	RD14BB2E154J	Carbon	150kΩ	±5%	1/4W
R26	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R27	RN14BK2E1003F	Metal film	100kΩ	±1%	1/4W
R28	R92-0709-05	Metal film	3MΩ	±1%	1W
R29	RN14BK2H1004F	Metal film	1MΩ	±1%	1/2W
R30	RN14BK2H5003F	Metal film	500kΩ	±1%	1/2W
R31	RN14BK2E3003F	Metal film	300kΩ	±1%	1/2W
R32	RN14BK2E1003F	Metal film	100kΩ	±1%	1/2W
R33	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R34	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R35	RD14BB2E683J	Carbon	68kΩ	±5%	1/4W
R36	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R37	RD14BB2E822J	Carbon	8.2kΩ	±5%	1/4W
R38	RD14BB2E103J	Carbon	100kΩ	±5%	1/4W
R39	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R40,41	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R42	RD14BB2E103J	Carbon	100kΩ	±5%	1/4W
R43	RD14BB2E153J	Carbon	150kΩ	±5%	1/4W
R44	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R45	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R46,47	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R48	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R49	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R50	RD14BB2E182J	Carbon	1.8kΩ	±5%	1/4W
R51	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R52	RD14BB2E185J	Carbon	1.8MΩ	±5%	1/4W
R53	RD14BB2E224J	Carbon	220kΩ	±5%	1/4W
R55,56	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R57	RD14BB2E363J	Carbon	36kΩ	±5%	1/4W
R58	RD14BB2E823J	Carbon	82kΩ	±5%	1/4W
R59	RD14BB2E563J	Carbon	56kΩ	±5%	1/4W
R60	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R61	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R62	RD14BB2E205J	Carbon	2MΩ	±5%	1/4W
R63	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R64	RD14BB2E123J	Carbon	12kΩ	±5%	1/4W
R65	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R66	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R67	RD14BB2E683J	Carbon	68kΩ	±5%	1/4W
R68	RD14BB2E564J	Carbon	560kΩ	±5%	1/4W
R69	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R70	RD14BB2E680J	Carbon	68Ω	±5%	1/4W
R71	RD14BB2E391J	Carbon	390Ω	±5%	1/4W
R72	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R73	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R74,75	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R76,77	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R78,79	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R80 ~ 82	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R83	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R84	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R85	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R86	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R87	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R88	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R89	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R90	RD14BB2E822J	Carbon	8.2kΩ	±5%	1/4W
R91	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R92	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R93	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R94	RD14BB2E822J	Carbon	8.2kΩ	±5%	1/4W
R95	RD14BB2E273J	Carbon	27kΩ	±5%	1/4W
R96	RD14BB2E123J	Carbon	12kΩ	±5%	1/4W
R97	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R98	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R99	RD14BB2E183J	Carbon	18kΩ	±5%	1/4W
R100	RD14BB2E822J	Carbon	8.2kΩ	±5%	1/4W
R101	RD14BB2E562J	Carbon	5.6kΩ	±5%	1/4W
R102	RD14BB2E122J	Carbon	1.2kΩ	±5%	1/4W
R103	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R104	RD14BB2E123J	Carbon	12kΩ	±5%	1/4W
R105	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R106	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R107	RD14BB2E103J	Carbon	10KΩ	±5%	1/4W
R108	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R109	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R110	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R111	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R112	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R113	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R114	RD14BB2E272J	Carbon	2.7kΩ	±5%	1/4W
R115	RS14AB3A393J	Metal oxide film	39kΩ	±5%	1W
R116	RD14BB2E821J	Carbon	820Ω	±5%	1/4W
R117	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R118,119	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R120	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R121	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R122	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R123	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R124	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R125	RD14BB2E681J	Carbon	680Ω	±5%	1/4W
R126,127	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R128	RS14AB3D472G	Metal oxide film	4.7kΩ	±2%	2W
R129	RS14AB3D512G	Metal oxide film	5.1kΩ	±2%	2W
R130,131	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
VR1	R12-3041-05	Semi-fixed	10kΩB		
VR2,3	R12-5025-05	Semi-fixed	100kΩB		
VR4	R01-2501-05	Variable with switch (S2)	5kΩB		
VR5	R12-5025-05	Semi-fixed	100kΩB		
VR6	R12-1028-05	Semi-fixed	4.7kΩB		
VR7	R12-3507-05	Semi-fixed	15kΩ		
VR8	R01-4024-15	Variable with switch (S1)	50kΩB		
VR9	R12-8501-05	Semi-fixed	2.2MΩB		
VR10	R12-3042-05	Semi-fixed	47kΩB		

PARTS LIST

Ref. No.	Parts No.	Description
VR11~13	R12S1029-05	Semi-fixed 1kΩB
VR14	R12-2020-05	Semi-fixed 6.8kΩB
VR15	R12-3040-05	Semi-fixed 22kΩB
VR16	R12-3041-05	Semi-fixed 10kΩB
VR17,18	R12-0502-05	Semi-fixed 100kΩB
VR19	R12-1028-05	Semi-fixed 4.7kΩB
	CAPACITOR	
C1,2	CQ93M1H682K	Mylar 6800pF ±10%
C3	CE04W1A101	Electrolytic 100μF 10WV
C4	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C5	CC45SL1H020C	Ceramic 2pF ±0.25pF
C6~8	CE04W1H010	Electrolytic 1μF 50WV
C9	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C10	CE04W1A470	Electrolytic 47μF 10WV
C11	CC45SL1H221J	Ceramic 220pF ±5%
C12	CE04W1A221	Electrolytic 220μF 10WV
C13	CK45D1A103M	Ceramic 0.01μF ±20%
☆14	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C15	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
☆16	C9-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C17	CK45D1H103M	Cermic 0.01μF ±20%
C18	CC45SL1A100D	Ceramic 10pF ±0.5pF
C19	CC45CH1H330J	Ceramic 33pF ±5%
C20	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C21	CK45D1H222M	Ceramic 2200pF ±20%
C22	C90-0320-05	Metalized film 0.47μF ±1%
C23	C90-0321-05	Metalized film 0.0047μF ±1%
C24	CC45CH1H330J	Ceramic 33pF ±5%
C25	CC45CH1H100D	Ceramic 10pF ±0.5pF
C26	CC45SL1H050C	Ceramic 5pF ±0.25pF
C27,28	CS15E1VR22M	Tantalum electrolytic 0.22μF 35WV
C29	CQ93M1H222K	Mylar 2200pF ±10%
C30	CK45D1H102M	Ceramic 1000pF ±20%
C31	CC45SL1H151J	Ceramic 150pF ±5%
C32	CC45CH1H180J	Ceramic 18pF ±5%
C33,34	CQ93M1H152K	Mylar 1500pF ±10%
C35	CK45D1H152M	Ceramic 1500pF ±20%
C36	CK45B1H681K	Ceramic 680pF ±10%
C37	CC45SL2H010C	Ceramic 1pF ±0.25pF
C39	CQ93M1H153K	Mylar 0.015μF ±10%
C40	CC45SL2H101J	Ceramic 100pF ±5%
C41	CC45SL1H150J	Ceramic 15pF ±5%
C42	CK45D2H332M	Ceramic 3300pF ±20%
C43	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C44	CK45D1H103M	Ceramic 0.01μF ±20%
C45	C90-0298-05	Ceramic 0.01μF ±20%
C46	CC45SL1H470J	Ceramic 47pF ±5%
C47,48	CE04BW1H010M	Electrolytic 1μF 50WV
C49	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C50,51	CK45D1H103M	Ceramic 0.01μF ±20%
C52	CC45SL1H150J	Ceramic 15pF ±5%
C53,54	CC45SL1H020C	Ceramic 2pF ±0.25pF
C55	CK45D1H103M	Ceramic 0.01μF ±20%
C56	CE04BW1H010M	Electrolytic 1μF 50WV
C57	CE04W1A101	Electrolytic 100μF 10WV
C58	CQ93M1H103K	Mylar 0.01μF ±10%
C59,60	CK45D1H103M	Ceramic 0.01μF ±20%
C61	CC45SL1H150J	Ceramic 15pF ±5%
C62,63	CK45D1H103M	Ceramic 0.01μF ±20%
C64	CC45CH1H050C	Ceramic 5pF ±0.25pF
C65	CK45D1H103M	Ceramic 0.01μF ±20%
C66	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C67,68	CC45SL1H221J	Ceramic 220pF ±5%
C69	CK45D2H102M	Ceramic 1000pH ±20%
C70	CC45SL1H151J	Ceramic 150pF ±5%
C71	CC45SL1H471J	Ceramic 470pF ±5%
C72	CE04W1A101	Electrolytic 100μF 10WV
C73	CE04W1C471Q	Electrolytic 470μF 16WV
C74	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C75	CE04W1C471Q	Electrolytic 470μF 16WV
C76	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C77	CE04W1A470	Electrolytic 47μF 10WV
C78	CC45SL1H471J	Ceramic 470pF ±5%
TC1	C05-0405-05	Ceramic trimmer 20pF
TC2	C05-0404-05	Ceramic trimmer 10pF
TC3	C05-0403-05	Ceramic trimmer 6pF
	SEMICONDUCTOR	
D1		Diode, germanium 1N60
D2~4		Diode, silicon 1S1555
D5		Diode, germanium 1N60
D6		Diode, silicon 1S1587
D7~14		Diode, silicon 1S1555
D16,17		Diode, silicon 1S1555
D18~20		Diode, germanium 1N60
D21,22		Diode, silicon 1S1555
D23		Diode, zener YZ-030
D24~26		Diode, silicon 1S1555
Q1~7		Transistor, NPN silicon 2SC945(P)
Q8,9		Transistor, PNP silicon 2SA733(Q)
Q10		Transistor, NPN silicon 2SC945(P)
Q11		FET 2SK30A(O)
Q12		Transistor, NPN silicon 2SC945(P)
Q13		FET 2SK30A(O)
Q14~16		Transistor, NPN silicon 2SC945(P)
Q18		FET 2SK30A(O)
Q19,20		Transistor, NPN silicon 2SC945(P)
Q21		FET 2SK30A(O)
Q22		Transistor, PNP silicon 2SA733(Q)
Q23		Transistor, NPN silicon 2SC945(P)
Q24		Transistor, NPN silicon 2SC535(C)
Q25~30		Transistor, NPN silicon 2SC945(P)
Q31,32		Transistor, NPN silicon 2SC1507
IC1		IC, Digital SN74H00N
IC2		IC, Digital SN74H72N
IC3		IC, Digital NJM555D
IC4		IC, Digital SN7400N
IC5		IC, Digital RC733T
IC6,7		IC, Digital SN74LS00N
	MISCELLANEOUS	
L1	L40-1092-02	Ferri-inductor 1mF
L2	L40-1511-03	Ferri-inductor 150μH
L3	L40-4701-03	Ferri-inductor 47μH
L4,5	L40-1511-03	Ferri-inductor 150μH
L6,7	L40-4701-03	Ferri-inductor 47μH
L8	L40-1011-03	Ferri-inductor 100μH
L9	L40-4701-03	Ferri-inductor 47μH
L10	L40-3311-03	Ferri-inductor 330μH
S2	S29-2504-05	Rotary switch
S3,4	S37-2005-05	Lever switch
S5	S32-2013-05	Lever switch
—	J25-2868-03	Printed circuit board
—	E23-0046-04	Terminal ×13

PARTS LIST

Ref. No.	Parts No.	Description
–	E40-0767-05	Connector 7P
–	E40-0367-05	Connector 3P
–	E40-0808-05	Connector 8P
–	E02-0126-05	IC socket 8P
–	E02-0127-05	IC socket 14P

POWER SUPPLY (X68-1270-01) ☆ on under side of p.c.board

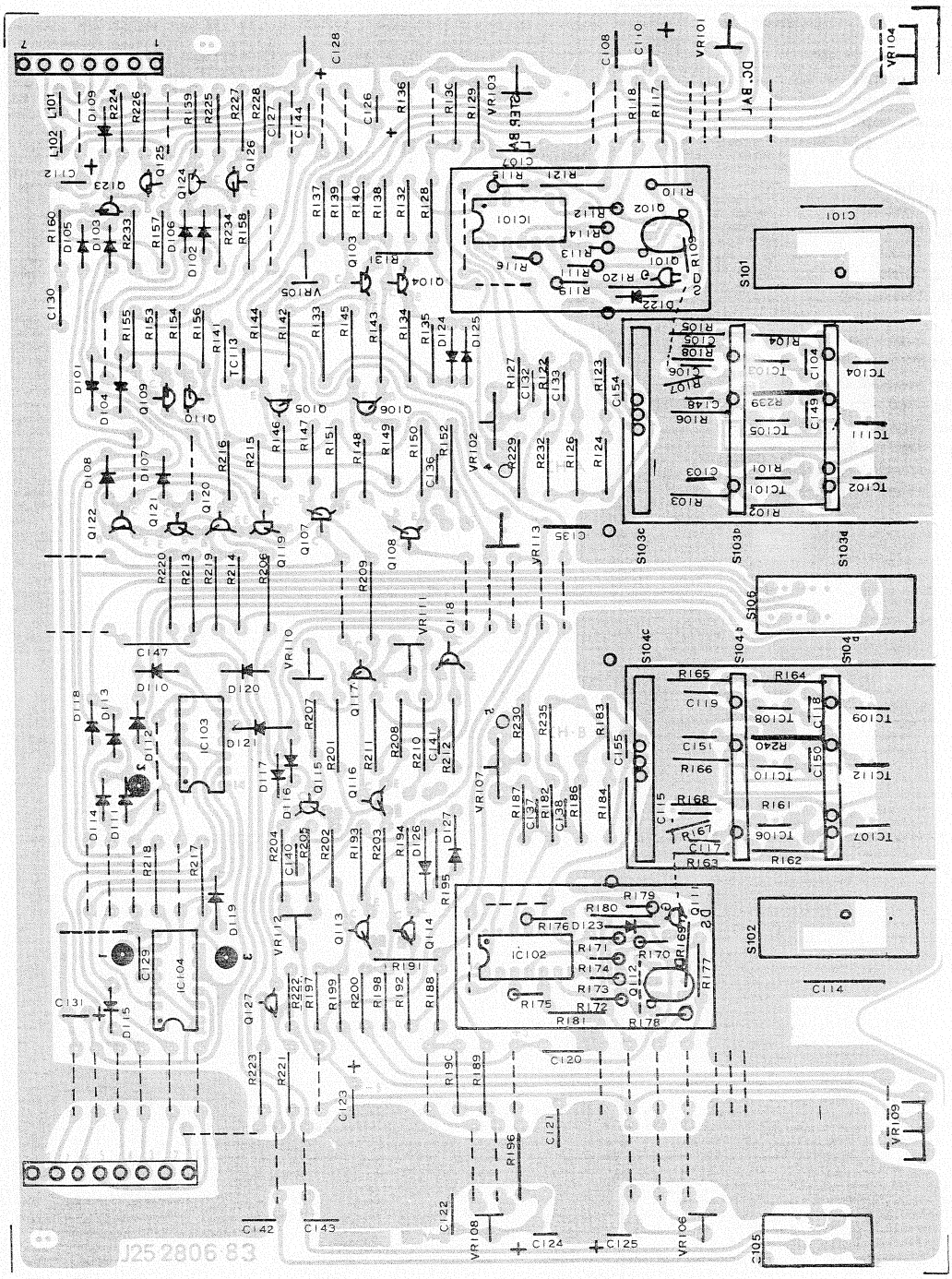
Ref. No.	Parts No.	Description			
		RESISTOR			
R302	R92-0707-05	Metal film	12MΩ	±5%	1W
R303	RC05GF2H275J	Carbon composition	2.7MΩ	±5%	1/2W
R304,305	RC05GF2H226K	Carbon composition	22MΩ	±10%	1/2W
R306	RC05GF2H473J	Carbon composition	47kΩ	±5%	1/2W
R307	RD14BB2E683J	Carbon	68kΩ	±5%	1/4W
R308	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R309	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R310	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R311	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R312	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R313	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R314	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R315	RN14BK2E1303F	Metal film	130kΩ	±1%	1/4W
R317	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R318	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R319~321	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R322	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R323	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R324	RD14BB2E333J	Carbon	33kΩ	±5%	1/4W
R325	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R326	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R327	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R328	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R329	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R330	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R331~333	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R334	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R335	RD14BB2E122J	Carbon	1.2kΩ	±5%	1/4W
R336,337	RD14BB2E2R2J	Carbon	2.2Ω	±5%	1/4W
R338	RN14BK2E4301F	Metal film	4.3kΩ	±1%	1/4W
R339	RN14BK2E8201F	Metal film	8.2kΩ	±1%	1/4W
R340	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R341	RN14BK2E1502F	Metal film	15kΩ	±1%	1/4W
R342	RN14BK2E1202F	Metal film	12kΩ	±1%	1/4W
R343	RD14BB2E2R2J	Carbon	2.2Ω	±5%	1/4W
R344	RN14BK2E6801F	Metal film	6.8kΩ	±1%	1/4W
R345	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R346	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R347	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R348	RN14BK2E9102F	Metal film	91kΩ	±1%	1/4W
R349,350	RD14BB2E4R7J	Carbon	4.7Ω	±5%	1/4W
R351	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R352	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R353	RS14GB3D511J	Metal oxide	510Ω	±5%	1/4W
R354	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R355	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R356	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R357~359	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
VR301	R12-5002-05	Semi-fixed	100kΩB		
VR302	R12-3004-05	Semi-fixed	47kΩB		
VR303	R12-3042-05	Semi-fixed	47kΩB		
VR304	R12-1002-05	Semi-fixed	1kΩB		
		CAPACITORS			
C304	CK45E3D102P	Ceramic	1000pF	+100%−0%	
C305~308	CK45E3D103P	Ceramic	0.01μF	+100%−0%	

Ref. No.	Parts No.	Description			
C309	CK45F1H103Z	Ceramic	0.01μF	+80%	−20%
C310	CE04W1H471	Electrolytic	470μF		50WV
C311	CQ93M1H153K	Mylar	0.015μF	±10%	
C312	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C313	CE04W2E3R3	Electrolytic	3.3μF		250WV
C314	CC45SL1H221J	Ceramic	220μF		50WV
C315	CC45CH2H020D	Ceramic	2pF	±05pF	
C316	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C317	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C318	CK45D2H332M	Ceramic	3300pF	±20%	
C319~321	CK45D2H103M	Ceramic	0.01μF	±20%	
C322	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C323	CE04W1A331	Electrolytic	330μF		10WV
C324	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C325	CE04W1C221	Electrolytic	220μF		16WV
C326	C90-0218-05	Electrolytic	3300μF		25WV
C327	CE04W1E222	Electrolytic	2200μF		25WV
C328	CE04W1E101	Electrolytic	100μF		25WV
C329	CE04W1H101	Electrolytic	100μF		50WV
C330	CE04W1A331	Electrolytic	330μF		10WV
C331	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C332,333	CK45D2H103M	Ceramic	0.01μF	±20%	
C334	CE04W2C100	Electrolytic	10μF		160WV
C335	CE04W2C101	Electrolytic	100μF		160WV
C336	CE04W1E330	Electrolytic	33μF		25WV
C337	CE04W2C100	Electrolytic	10μF		160WV
C338	CK45E3D103P	Ceramic	0.01μF	+100%−0%	
C339,340	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
C341,342	CE04W1E100	Electrolytic	10μF		25WV
C343	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%	−20%
TC301	C05-0401-05	Ceramic trimmer		20pF	
		SEMICONDUCTORS			
Q301		Transistor, NPN silicon		2SD401A-(K)	
Q302		Transistor, NPN silicon		2SC983-(Y)	
Q303		Transistor, NPN silicon		2SC945-(P)	
Q304		Transistor, NPN silicon		2SC1628-(Y)	
Q305		Transistor, PNP silicon		2SA818-(Y)	
Q306		Transistor, NPN silicon		2SC535-(B)	
Q307,308		Transistor, NPN silicon		2SC1419-(C)	
Q309		Transistor, PNP silicon		2SA755-(C)	
Q310		Transistor, PNP silicon		2SB546-(A)	
Q311		Transistor, PNP silicon		2SA733-(Q)	
Q312~316		Transistor, NPN silicon		2SC945-(P)	
Q317		Transistor, NPN silicon		2SC1384	
Q318		Transistor, NPN silicon		2SA684	
D301		Diode, silicon, high voltage		Y16JA	
D302	W02-0401-05	High voltage rectifier block			
D304~306		Diode, silicon		1S2463	
D307		Diode, silicon		1SS83	
D308~315		Diode, silicon		1S1555	
D316		Diode, zener		WZ-050	
D317		Diode, zener		WZ075	
D318		Diode, zener		WZ-150	
D319		Diode, rectifier, bridge		SIRBA40	
D320		Diode, rectifier, bridge		SIQB60	
D321,322		Diode, silicon		1S1555	
IC301		IC, Linear		RC4558T	
		MISCELLANEOUS			
P301	E40-0903-05	Connector, 9P			
P302	E40-0403-05	Connector, 4P			
P304	E40-0432-05	Connector, 4P			

PARTS LIST

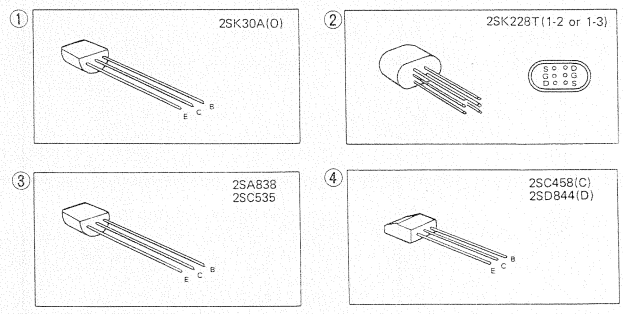
Ref. No.	Parts No.	Description
P305	E40-0532-05	Connector, 5P
P306	E40-0801-05	Connector, 8P
P307	E40-0802-05	Connector, 8P
P308	E40-0367-05	Connector, 3P
P309	E40-0267-05	Connector, 2P
–	F01-0801-04	Heat sink
–	F01-0813-05	Heat sink
–	F01-0825-04	Heat sink
–	F05-5016-05	Fuse 0.5A T
	F11-0911-33	Shield case
	F11-0912-04	Shield case
–	J13-0039-05	Fuse holder
–	J25-2861-33	Printed circuit board
N301 ~ 303		Neon lamp NE-2
–	E31-0665-05	Lead wire with connector IP (INTEND)
L301	L40-4711-03	Ferri-inductor 470μH
L302	L40-3391-03	Ferri-inductor 3.3μH
T301	L19-0402-05	Transformer (converter)
TH301		Thermistor SDT-1000

P. C. BOARD

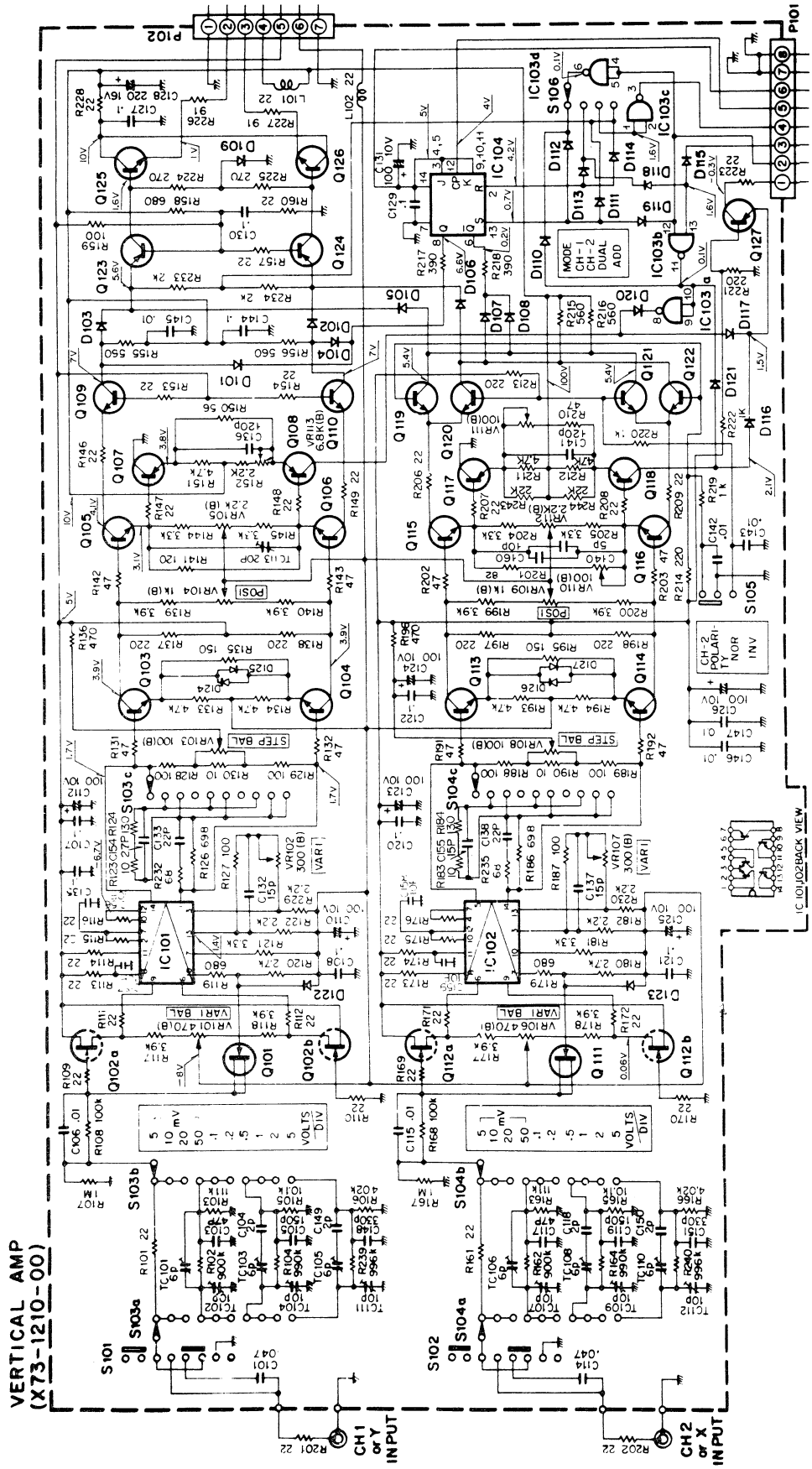


X73-1210-00

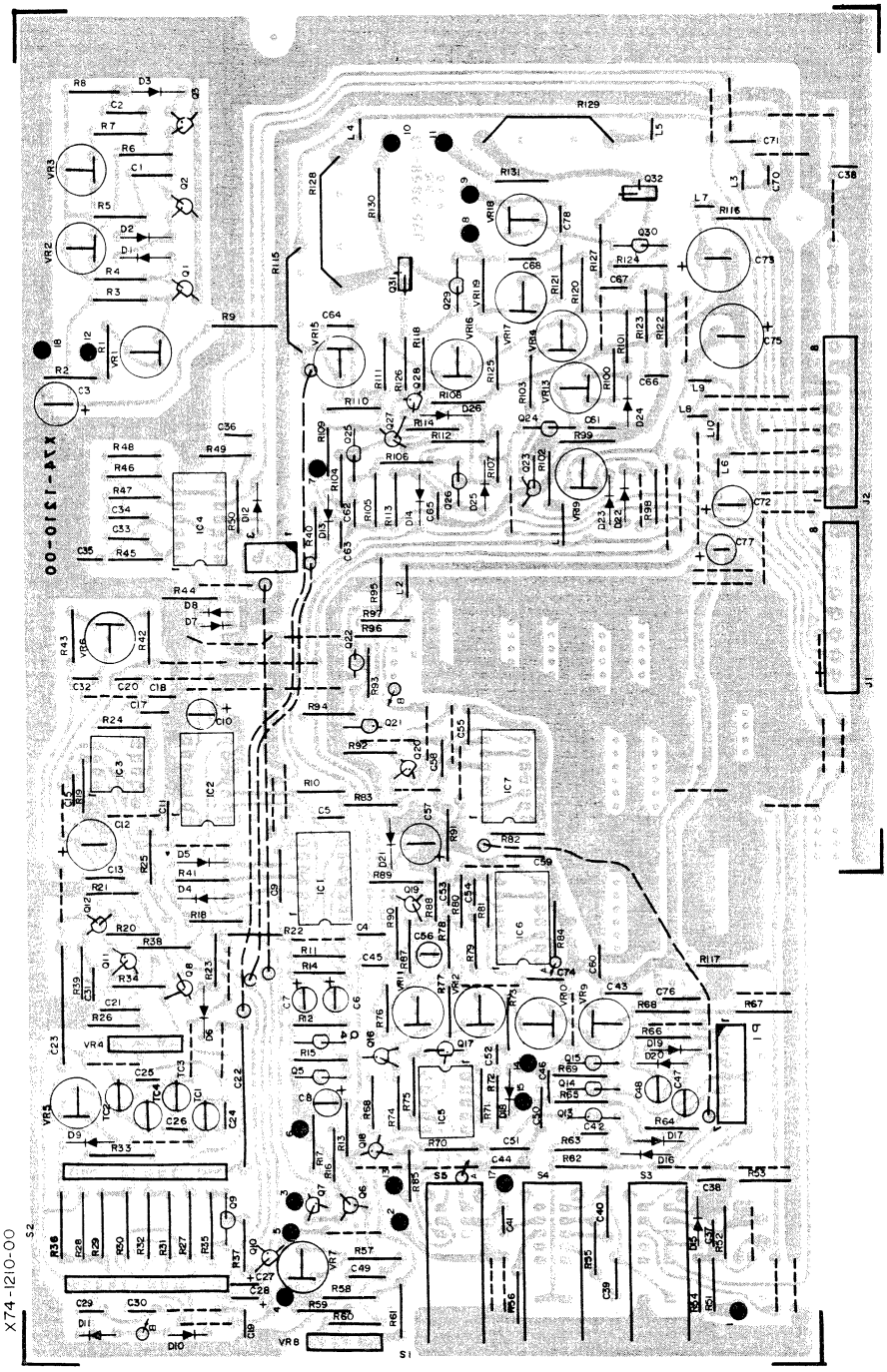
Ref. No.	Name	External view No.
Q101, 111	2SK30A(O)	1
Q102, 112	2SK228T-2 or 3	2
Q103~106, 109, 110 113~116, 119~122	2SC535(B)	3
Q123, 124, 127	2SA844D	4
Q125, 126	2SC458C	4
Q107, 108, 117, 118	2SA838(C)	3
D101~108, 122, 123	1S1587	—
D109~121	1S1555	—
D124~127	1N60	—
IC101, 102	HA1127	—
IC103	TD300AP	—
IC104	TD3472AP	—

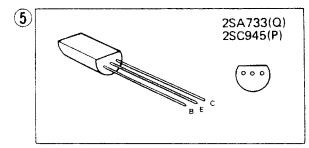


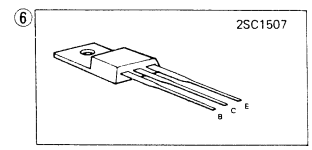
CIRCUIT DIAGRAM

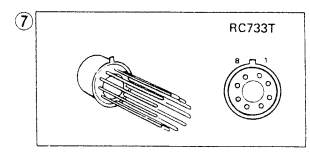


P. C. BOARD





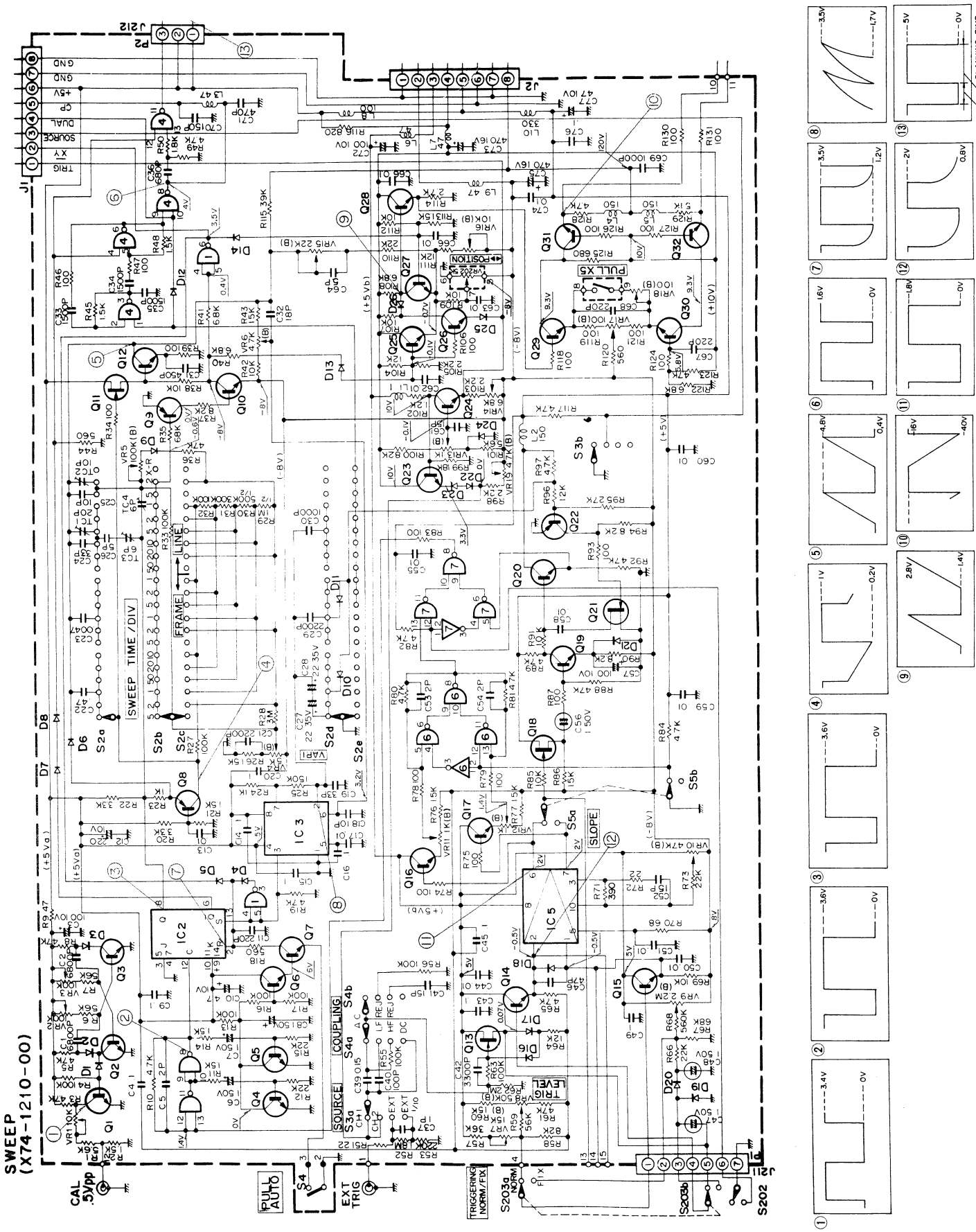




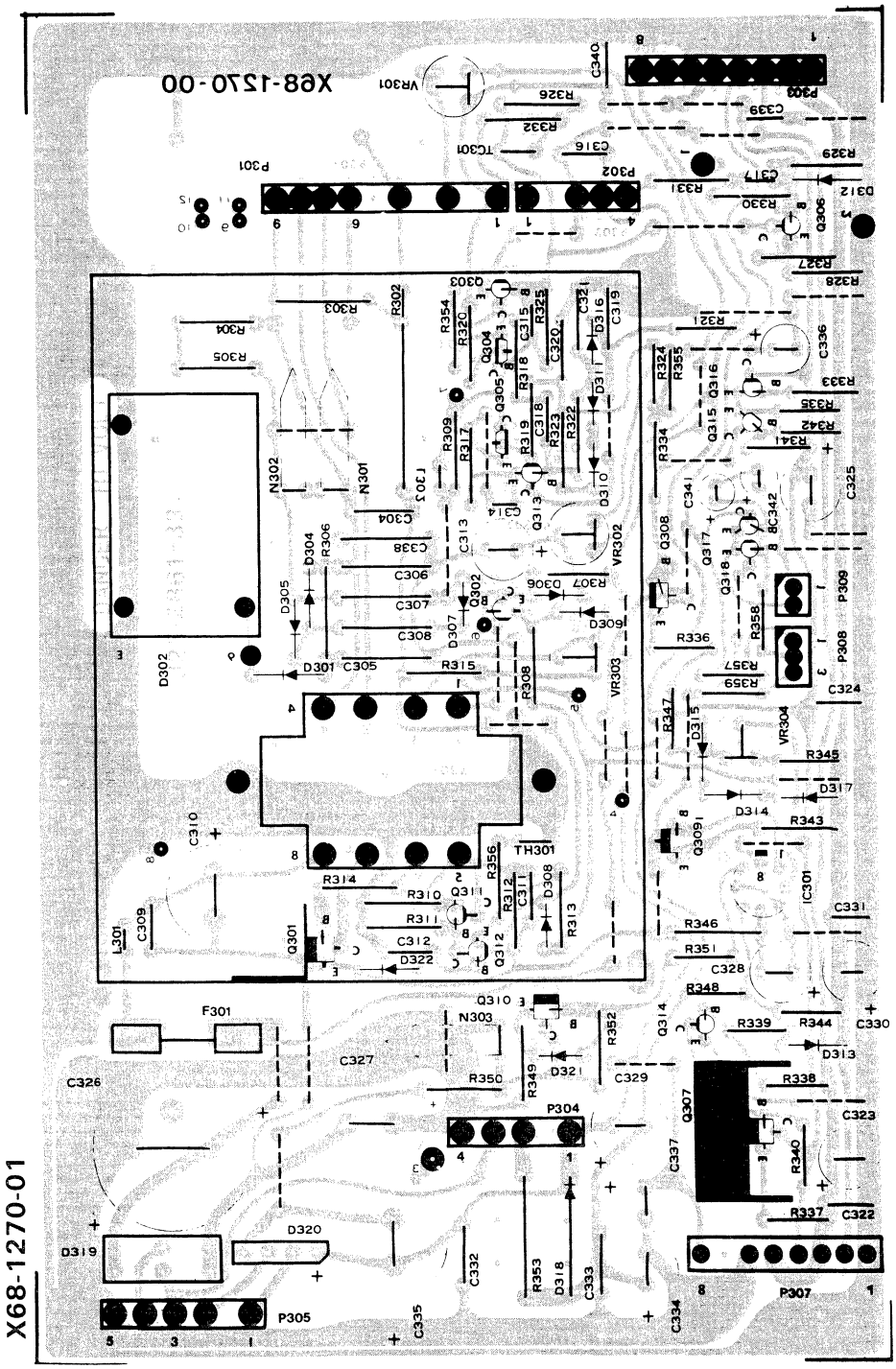
Ref. No.	Name	External view No.
Q1~7, 10, 12, 14, 16, 17 19, 20, 23, 25~30, 33	2SC945(P)	5
Q8, 9, 22, 34	2SA733(Q)	5
Q24	2SC535(C)	3
Q31, 32	2SC1507	6
Q11, 13, 18, 21	2SK30A(O)	1
Q15	2SK228T-2 or 3	2
D1, 5, 18	1N60	—
D2~4, 7~14, 16, 17, 21 22, 24~26	1S1555	—

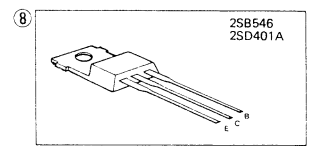
Ref. No.	Name	External view No.
D6	1S1587	—
D23	YZ-030	—
IC1	SN74H00N	—
IC2	SN74H72N	—
IC3	NJM555D	—
IC4	SN7400N	—
IC5	RC733T	7
IC6, 7	SN74LS00N	—

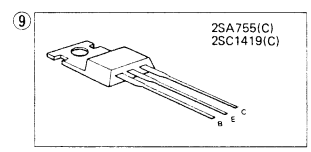
CIRCUIT DIAGRAM

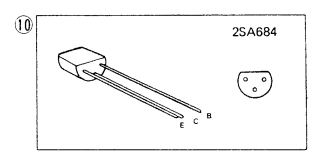


P. C. BOARD





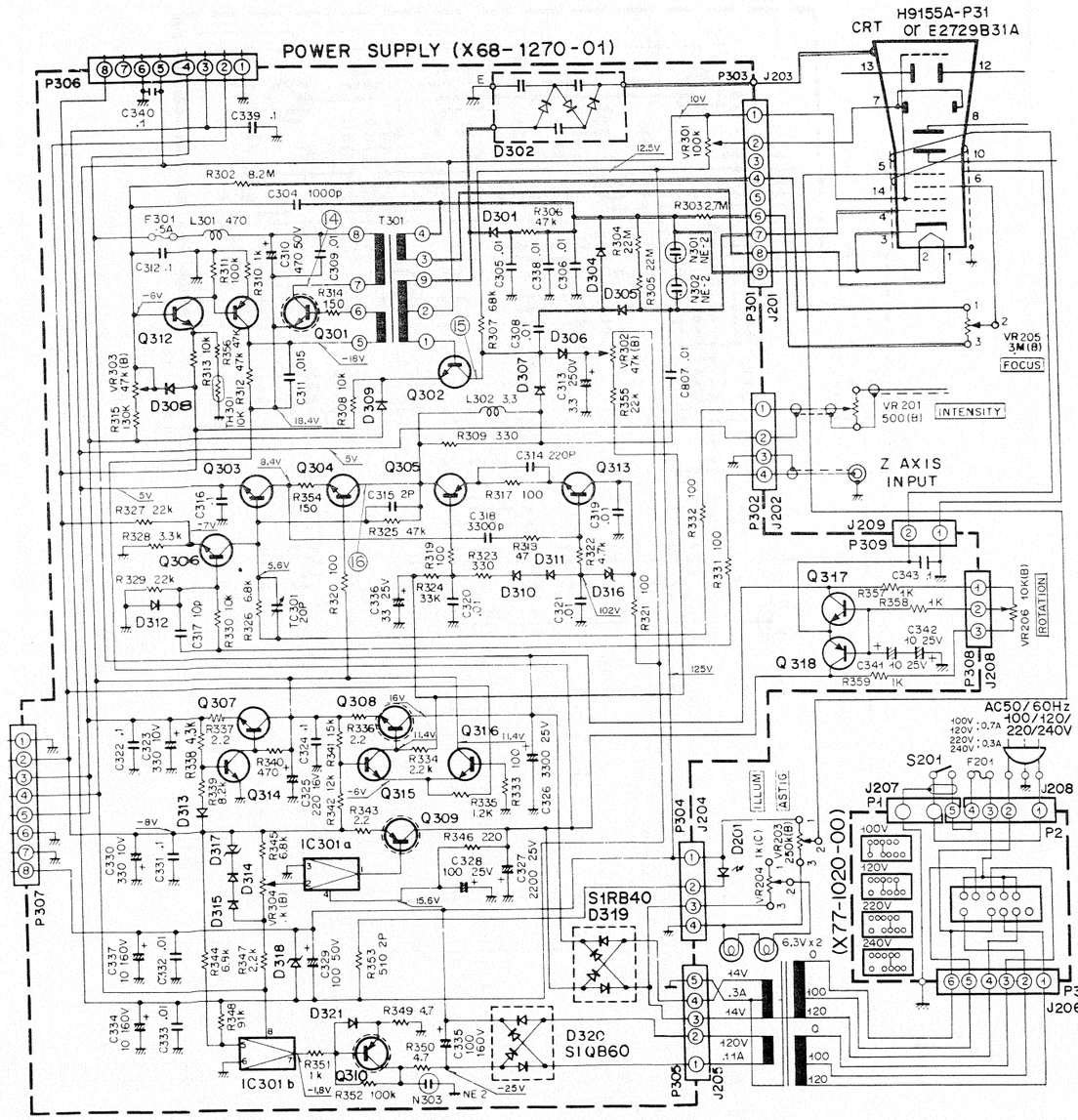




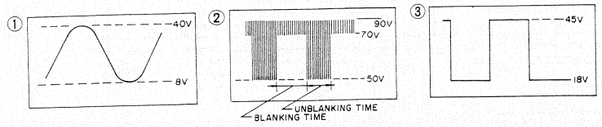
Ref. No.	Name	External view No.
Q301	2SD401A(K)	8
Q302	2SC983(Y)	
Q303,312~316	2SC945(P)	5
Q304	2SC1628(Y)	
Q305	2SA818(Y)	
Q306	2SC535(B)	3
Q307, 308	2SC1419(C)	9
Q309	2SA755(C)	9
Q310	2SB546A	8
Q311	2SA733(Q)	5
Q317	2SC1384	
Q318	2SA684	10

Ref. No.	Name	External view No.
D301	Y16JA	—
D302	Rectifier block(High-Voltage)	—
D304~306	1S2463	—
D307	1SS83	—
D308~315	1S1555	—
321, 322		
D316	WZ-050	—
D317	WZ-075	—
D318	WZ-150	—
D319	S1RB40	—
D320	S1QB60	—
IC301	NJM4558T	—

CIRCUIT DIAGRAM

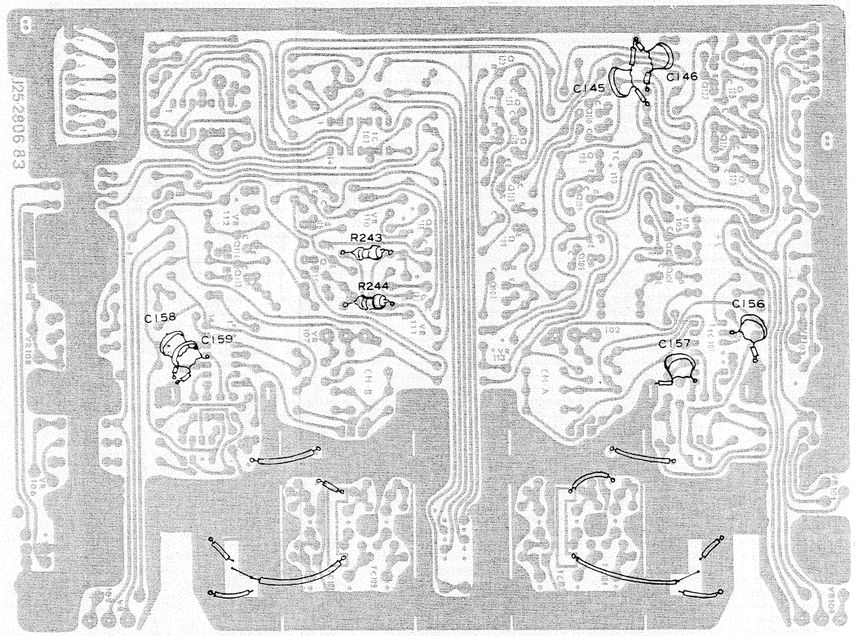


Be careful of the red line because high voltage is supplied to it.

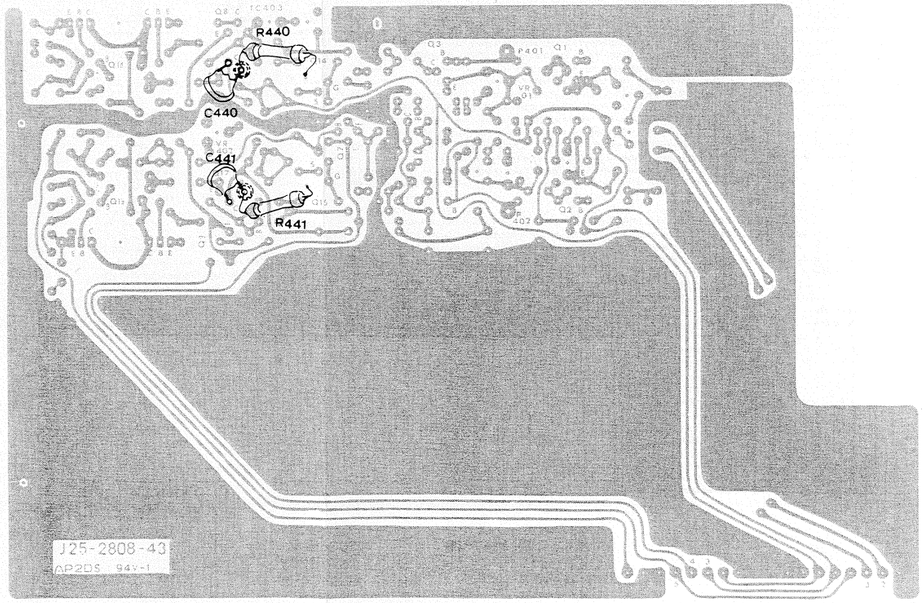


P. C. BOARD (on under side of p.c. board)

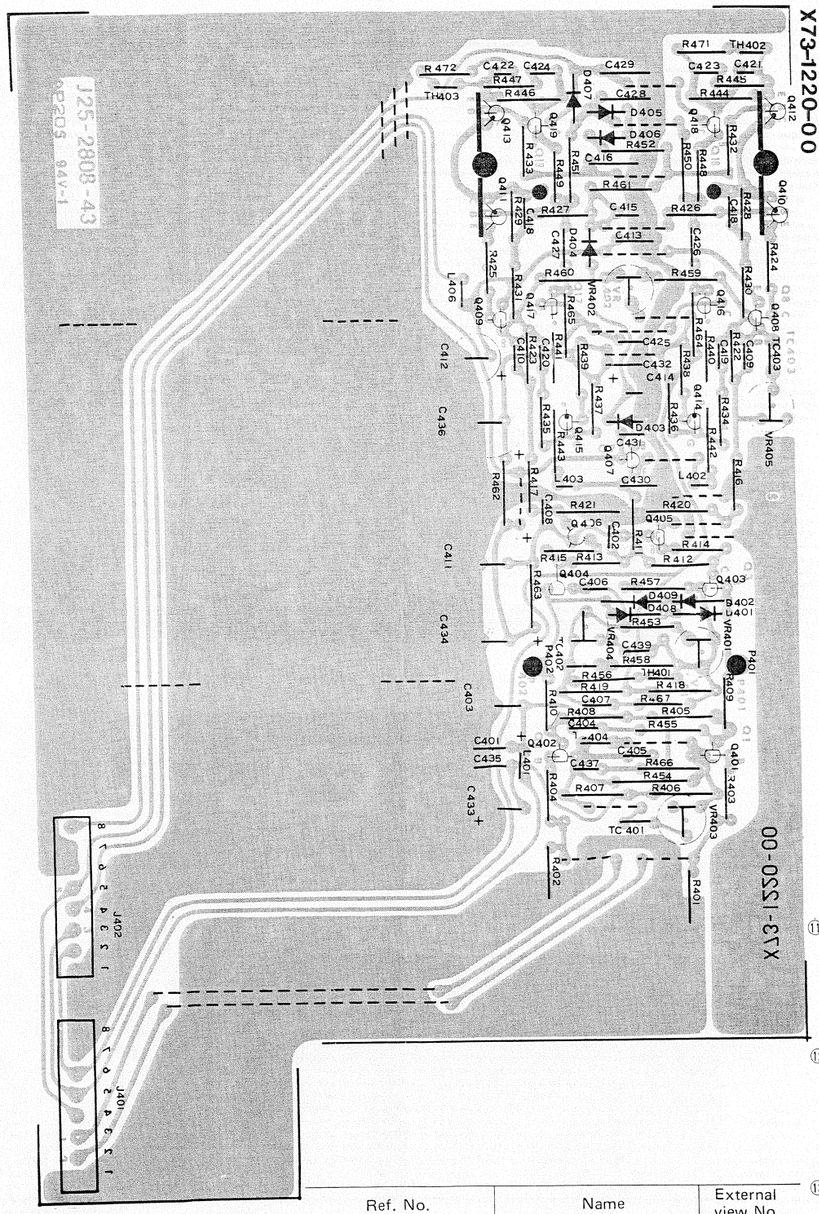
X73-1210-00

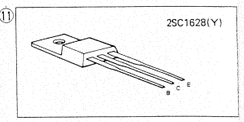


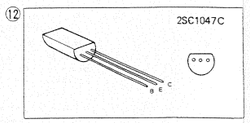
X73-1220-00

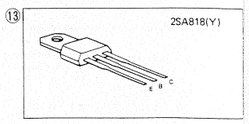


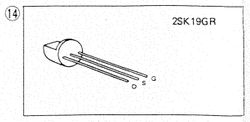
P. C. BOARD





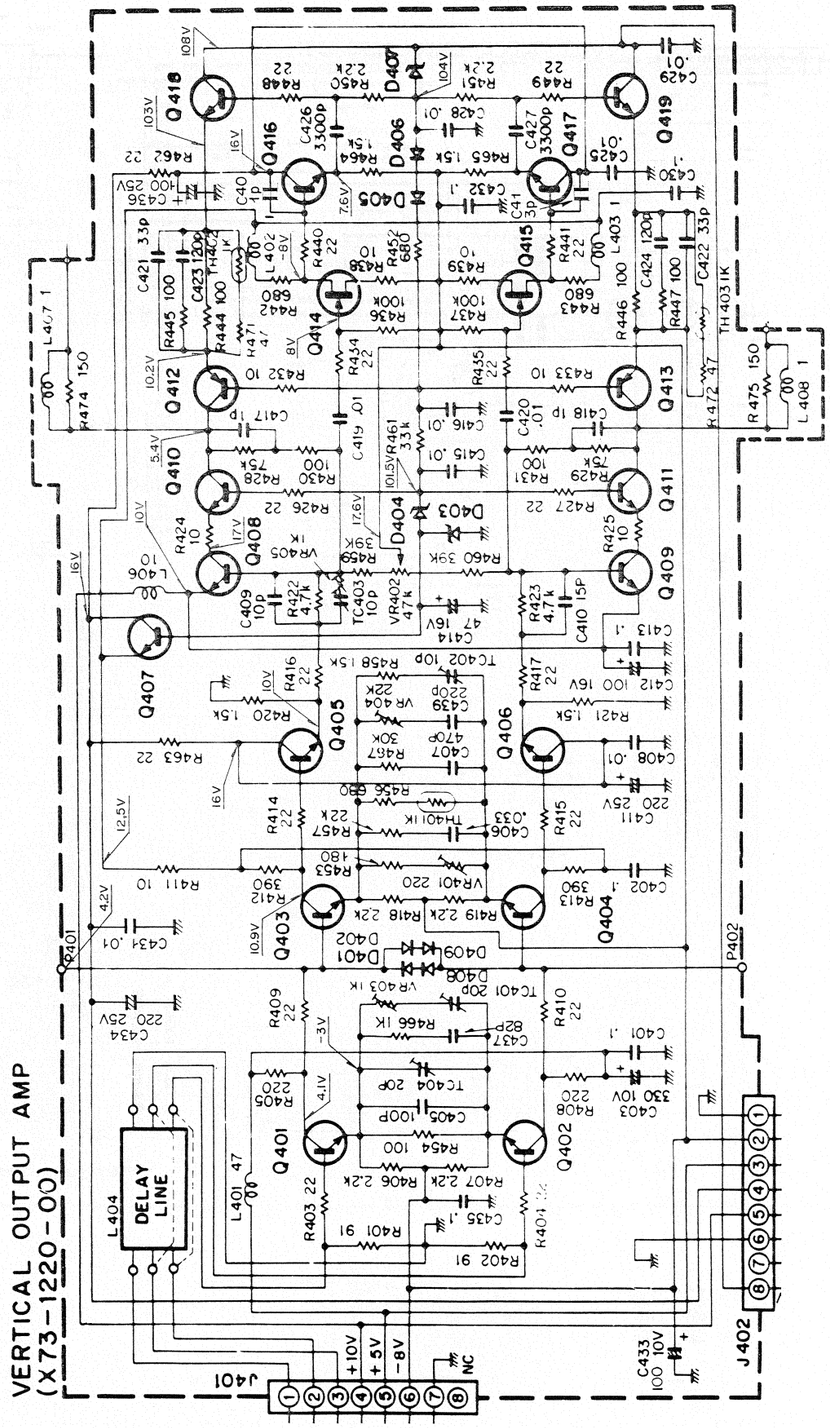




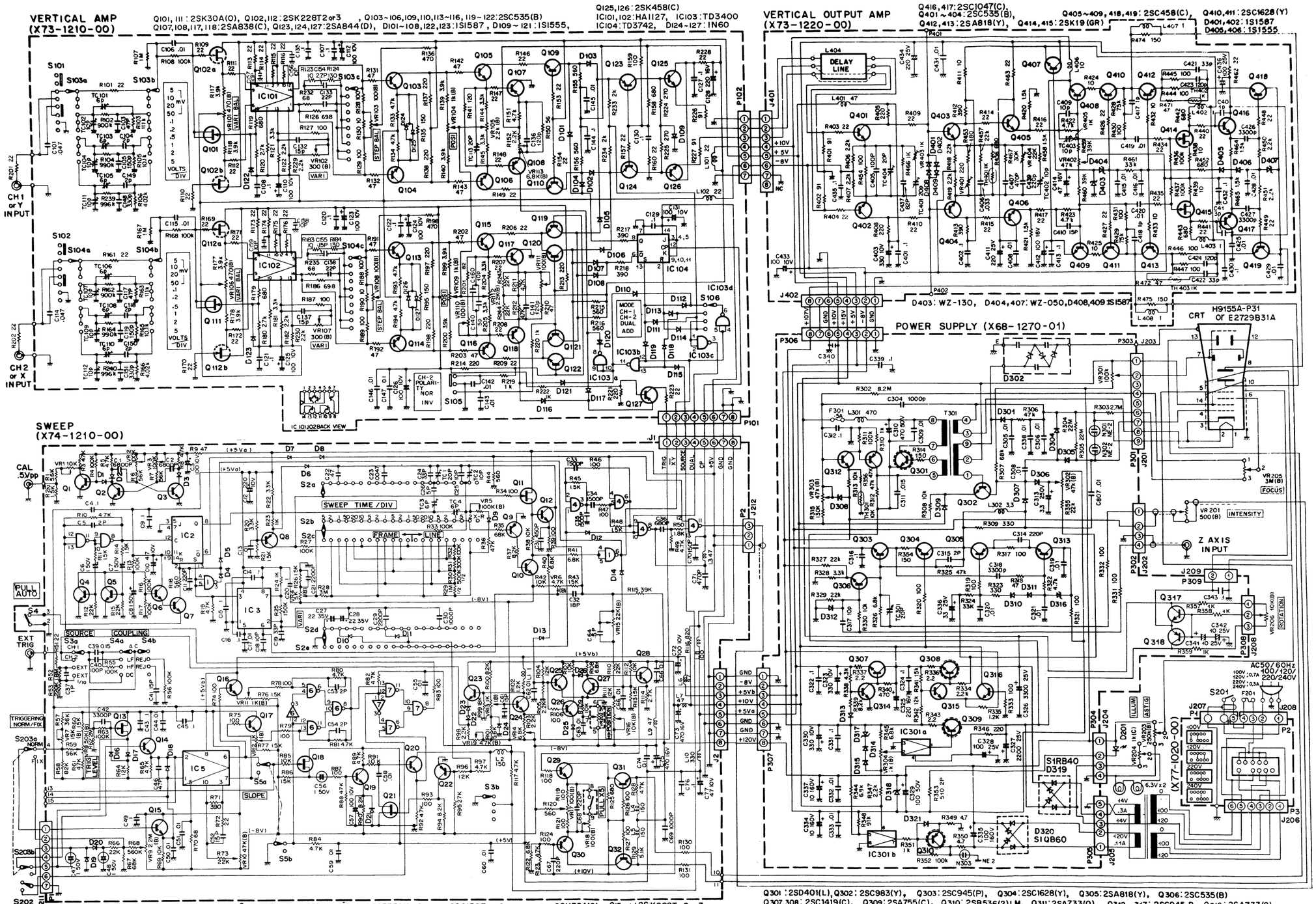


Ref. No.	Name	External view No.
Q401~404	2SC535B	3
Q405~409, 418, 419	2SC458C	4
Q410, 411	2SC1628Y	11
Q416, 417	2SC1047C	12
Q412, 413	2SA818Y	13
Q414, 415	2SK19GR	14
D401, 402	1S1587	—
D403	WZ-130	—
D404, 407	WZ-050	—
D405, 406	1S1587	—
D408, 409	1S1587	—

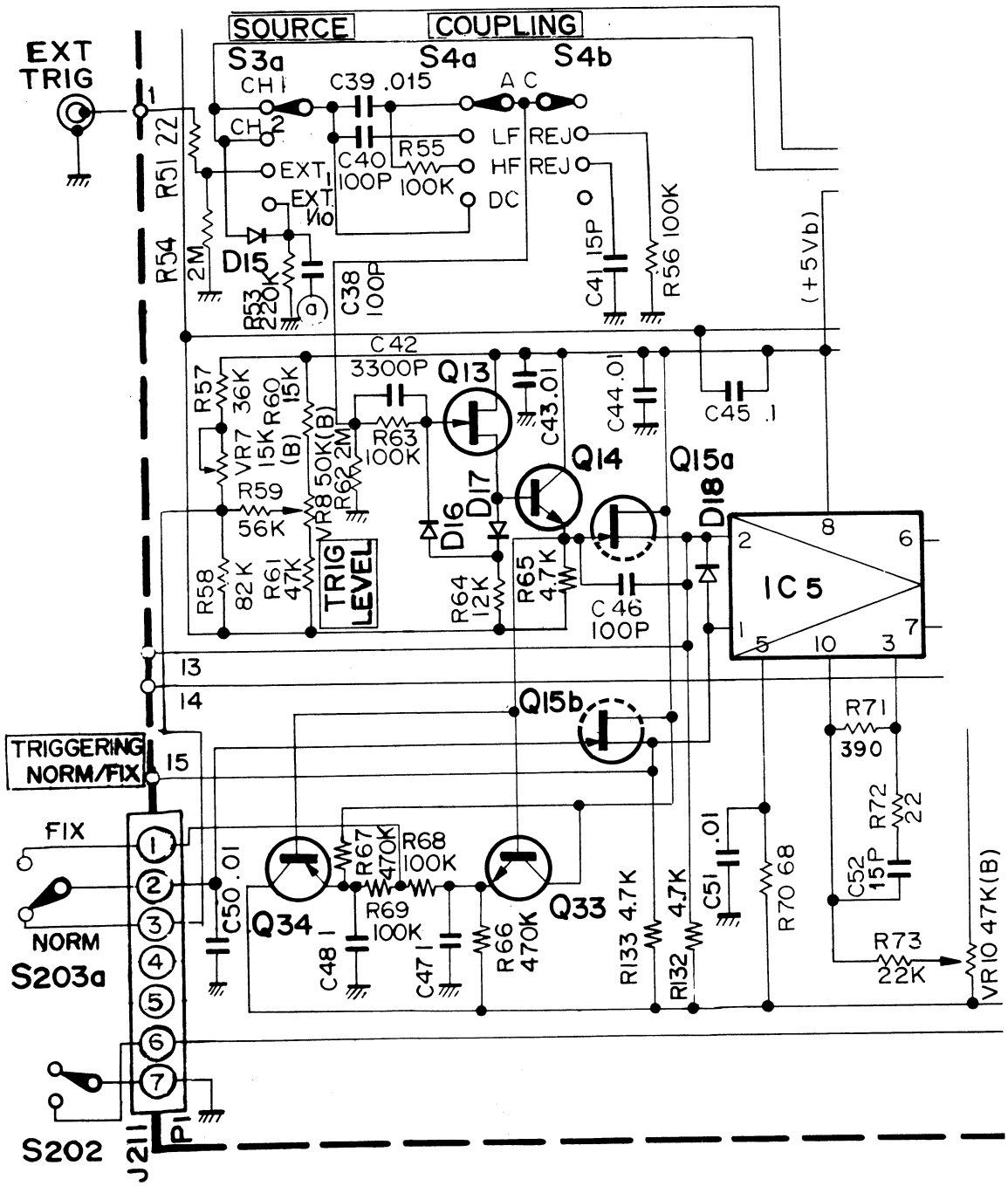
CIRCUIT DIAGRAM



SCHMATIC DIAGRAM



(X74-1210-00)



Change Information

The FIX circuit on X74-1210-00 has been modified as shown above for products with Serial No. 0040121 and Higher.